SAAB 9000

ENGINEERING FEATURES

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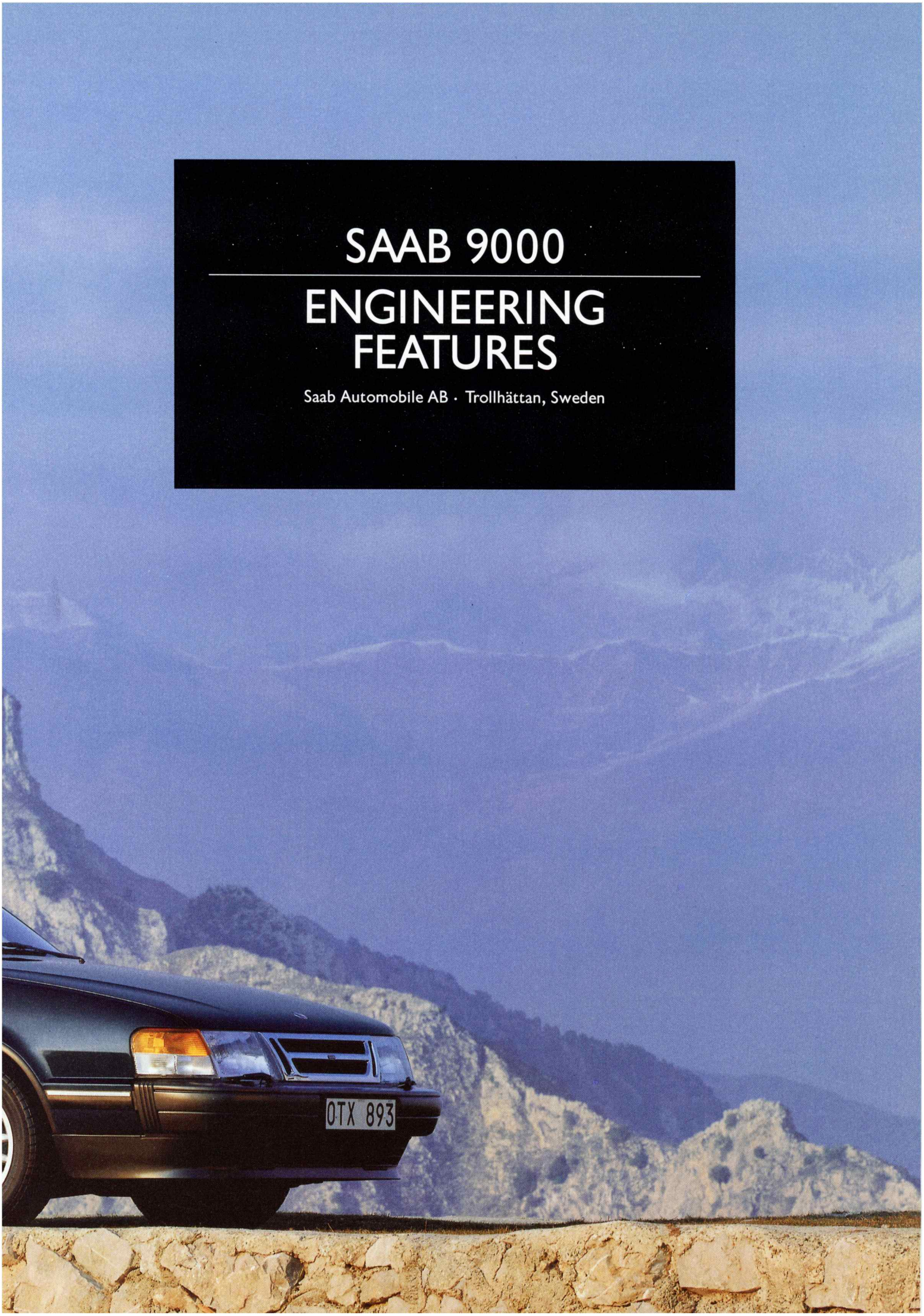
ENGINEERING FEATURES

Saab Automobile AB · Trollhättan, Sweden



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Saab Automobile AB
Trollhättan, Sweden

An important word about this brochure.

We hope you find this brochure helpful, as we have tried to make it as comprehensive and factual as possible. However, since this brochure was printed, some of the information you see within may have been updated. Also, some of the equipment described in the brochure is available at extra cost.

Further, certain photographs and illustrations in this brochure are also common to editions published for other markets. Consequently, certain details shown in these photographs or illustrations may not be available in the U.S. market.

Finally, we reserve the right to make changes at any time, without prior notice, in prices, colors, materials, equipment, specifications and models, including the discontinuation of models. Check with your Saab dealer for complete and up-to-date information before ordering.

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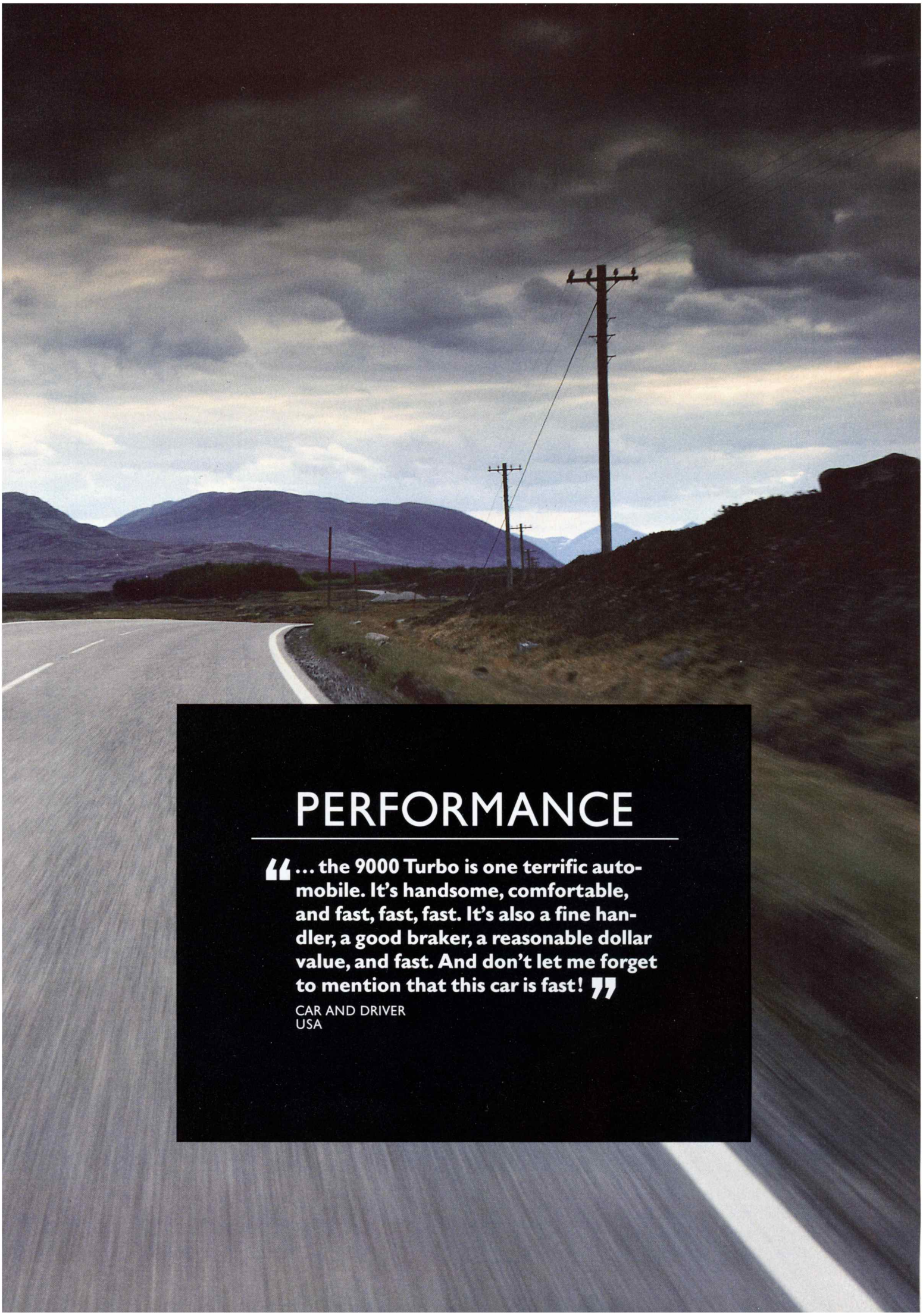


PERFORMANCE

"... the 9000 Turbo is one terrific automobile. It's handsome, comfortable, and fast, fast, fast. It's also a fine handler, a good braker, a reasonable dollar value, and fast. And don't let me forget to mention that this car is fast!"

CAR AND DRIVER
USA

Saab 16-valve engines are among the most sophisticated four-cylinder engines available anywhere today. Their innovative and ingenious technology gives them maximum performance, low fuel consumption and minimum maintenance requirements.

Engine

Saab has long been acknowledged as one of the leading manufacturers of car engines—both turbocharged and naturally-aspirated. Saab's objective has always been to design compact, lightweight power units, with high power-to-weight and power-to-bulk ratios. Four valves per cylinder ensure smooth gas flow and efficient combustion.

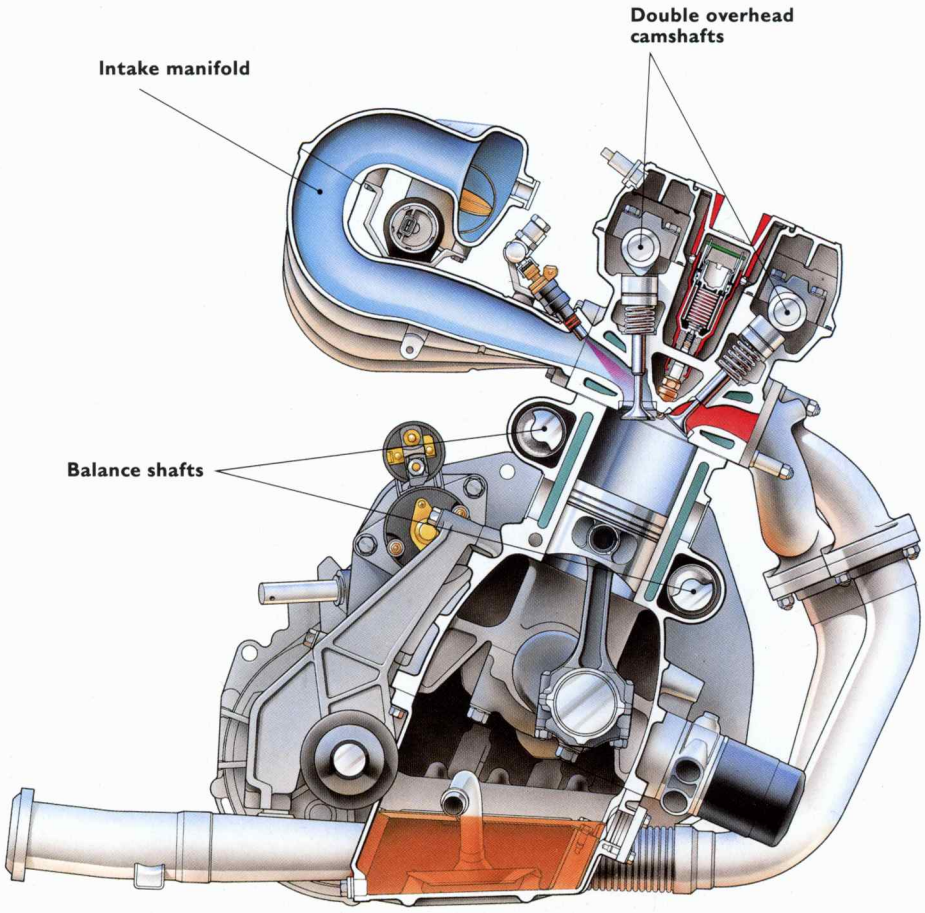
Saab has employed reliable design features such as double overhead camshafts and maintenance-free hydraulic lifters. Electronic fuel injection provides good fuel economy, cleaner exhaust gases and responsive performance, while twin couner-rotating balance shafts allow smoother, quieter operation. And to provide maximum reliability in any climate, Saab developed the Saab Direct Ignition (Saab DI) system.

Saab Turbo models are equipped with an intercooler and water-cooled turbocharger, for increased durability and lower maintenance costs. And the Automatic Performance Control (APC) system enables the engine to run on fuel of any octane rating from 87 AON and higher, provides efficient use of the fuel energy and increases the engine output.

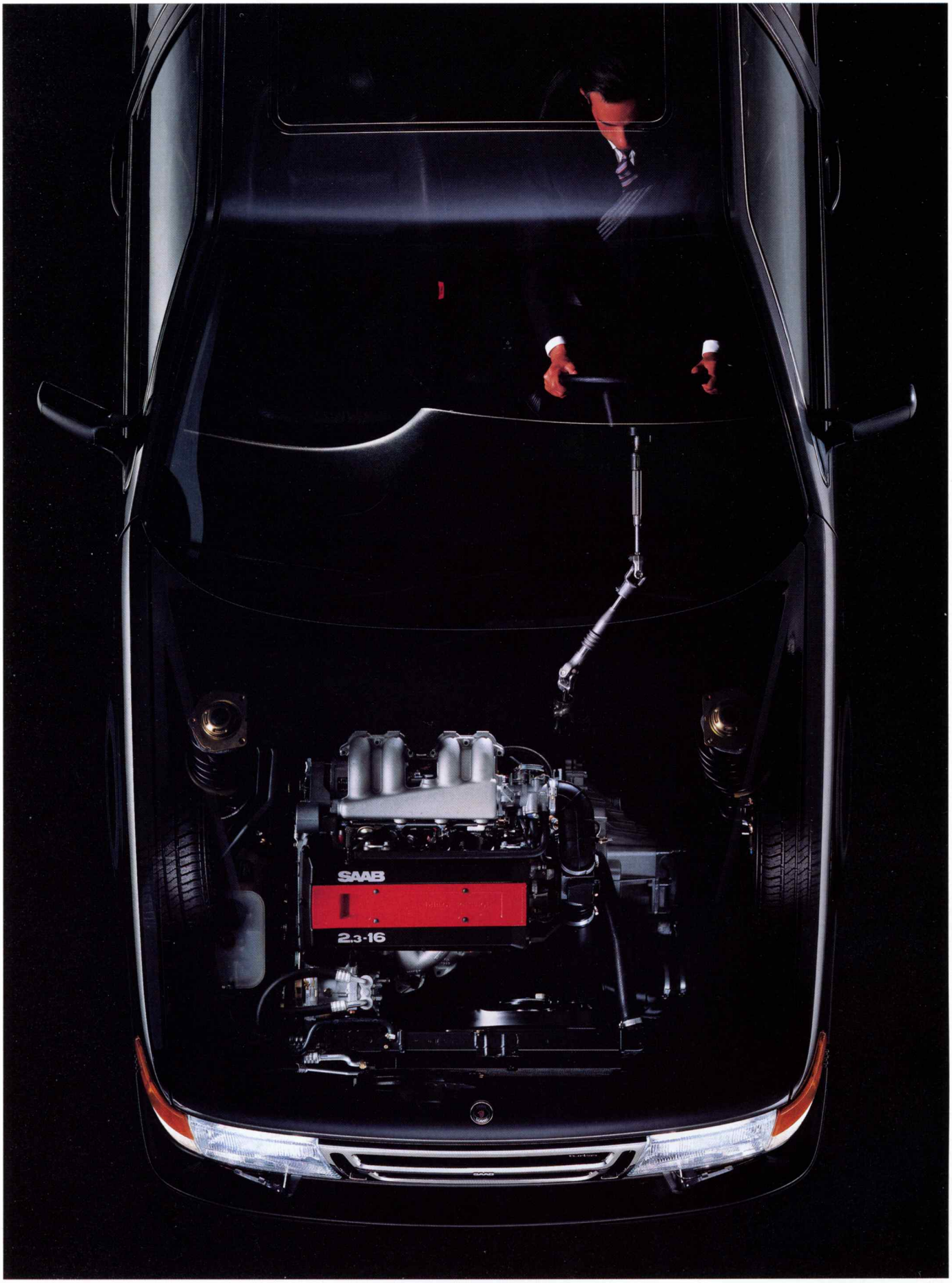
Transversely mounted engine and gearbox

On the transversely mounted power unit, the gearbox is located on the left side of the engine compartment. Since the integrated power unit is very compact, it occupies a very small proportion of the total volume of the car. Power is transmitted axially from the gearbox to the driven front wheels, which results in high efficiency. The transverse mounting also provides good collision protection and excellent cooling.

The engine is inclined 20° forward. As a result, the Saab 9000 has a low, sloping hood, which minimizes aerodynamic drag. The location of the engine forward of the driving wheels provides favorable weight distribution with the driving wheels supporting the majority of the weight.



Cross-section of the 2.3-liter 16-valve engine. The long inlet manifold which boosts the engine torque at low revs, contributes—together with the balancing shafts—to the low-speed performance and great driving comfort of the engine.



The Saab 9000 has front-wheel drive and a transversely-mounted engine. Thus the complete power train is compact, and it occupies only a small fraction of the car's volume.

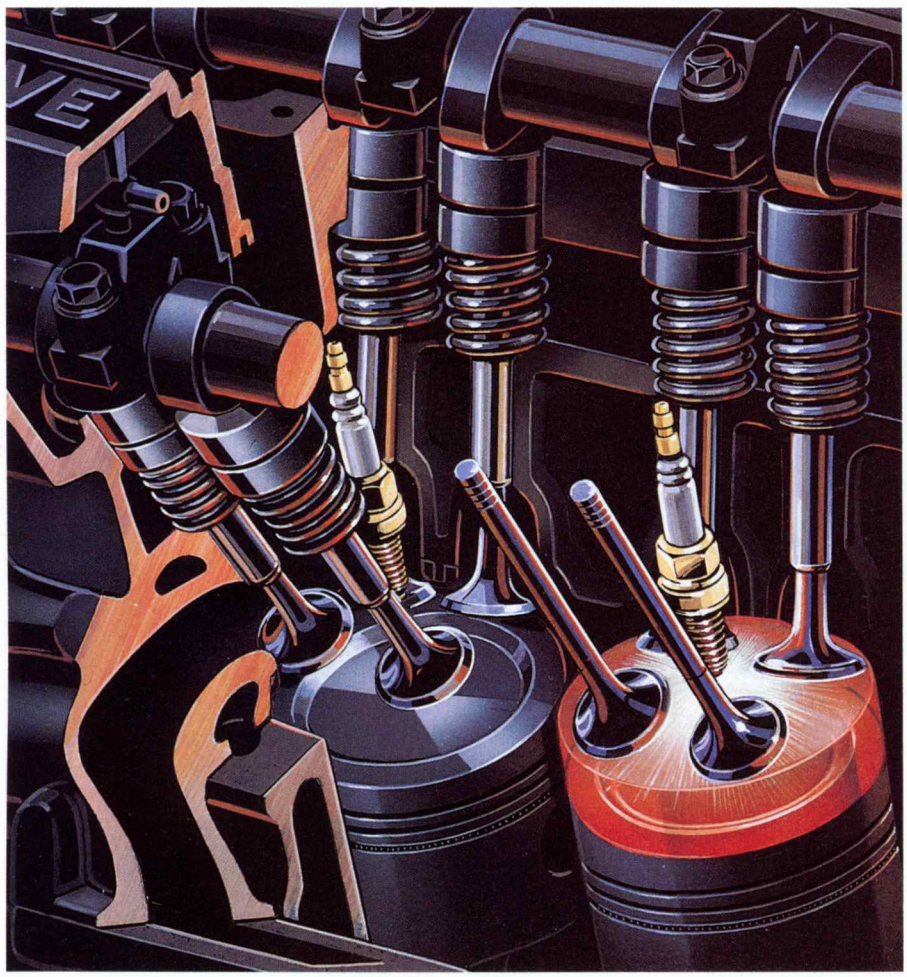
The Saab 16-valve engine for everyday motoring marks a new milestone in the development of internal combustion engines.

16-valve technology

Engines with four valves per cylinder have long been used to power rally and competition cars—including Saab cars. But the Saab 16-valve engine is not a competition engine designed for the highest possible performance within a narrow range of engine speeds. On the contrary, it is an everyday "workhorse", with good low-speed performance and designed for economy, durability and reliability. Most car manufacturers are developing engines with four valves per cylinder, and this design will probably dominate in the future. But Saab has already accumulated years of experience in the production of such engines for economical everyday motoring.

Combustion chamber design

The design of the combustion chamber is extremely favorable — it is dome-shaped, with a relatively flat piston crown—which contributes to high efficiency, low knocking tendencies and uniform combustion. The intake manifold is shaped to improve the turbulence in the combustion chamber.



The four-valve principle, with two intake and two exhaust valves, means better gas exchange, with more fuel mixture and exhaust gases flowing in and out during each combustion cycle.

The 16-valve engine provides top performance at the same time as remarkable economy and world-record durability.

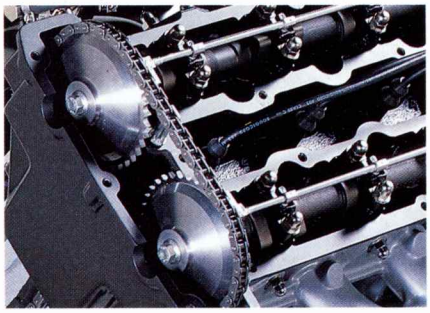
Because of uniqueness, Saab has filed patent applications for this design. Each of the two pairs of valves has a large flow area, and the engine can thus breath efficiently. Since the engine has four valves per cylinder instead of two, individual valves are subjected to far less demanding working conditions. Thermal stresses are appreciably lower at a given engine rating than those of an engine with only one intake and one exhaust valve per cylinder.

The four valve arrangement enables the spark plug to be located in the center of the combustion

chamber. Its flame spreads uniformly throughout the combustion chamber. Engine designers describe this as a short and uniform flame path.

In an engine with two valves per cylinder and the spark plug located on one side of the combustion chamber, the flame path is long and asymmetrical. If the temperature at the far end of the combustion chamber is high, the fuel/air mixture may pre-ignite before the flame has reached it, and the engine will "knock". To avoid such harmful knocking, the compression ratio in this type of engine must be fairly low.

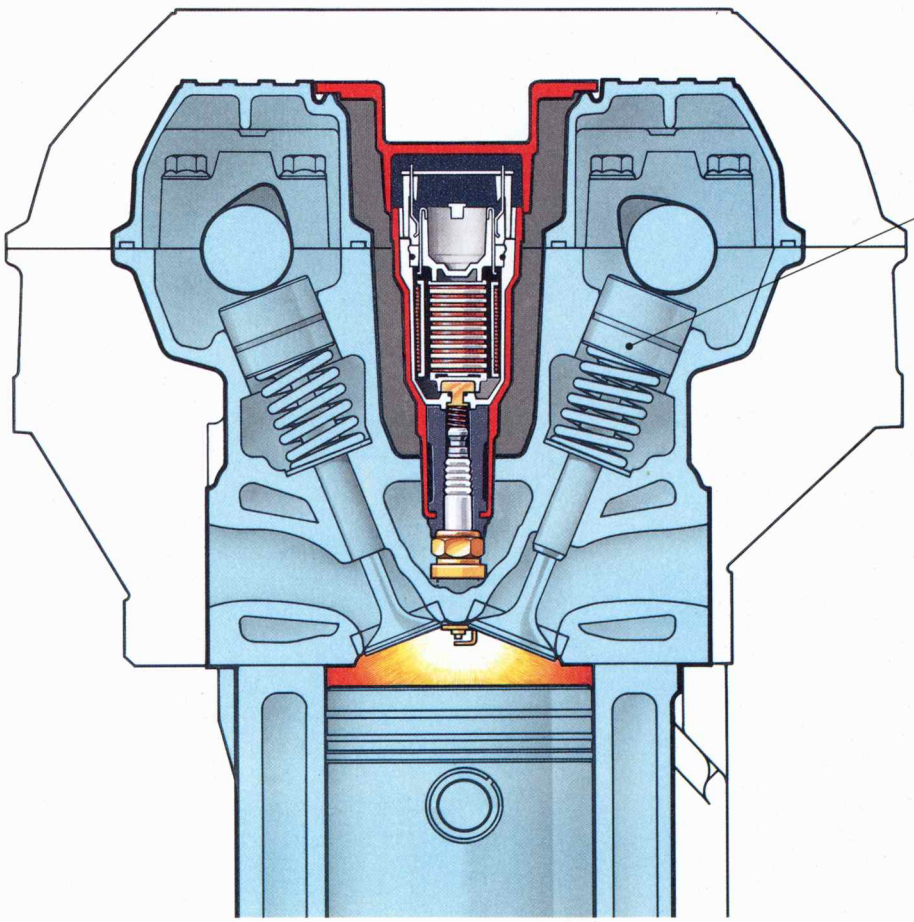
If the engine has four valves per cylinder with the spark plug located centrally, the compression ratio can be raised with less risk of pre-ignition and knocking. A high compression ratio increases the engine efficiency, enables the engine to use the energy in the fuel more effectively, and raises the engine power and low speed response, with a low fuel consumption. The Saab APC system plays an important role in this respect on the turbocharged engine. On the naturally-aspirated 16-valve engine, the knock sensor is integrated into the control of the ignition system. Due to the knock sensors in both systems, the engines can be run on any grade of fuel from 87 AON and higher.



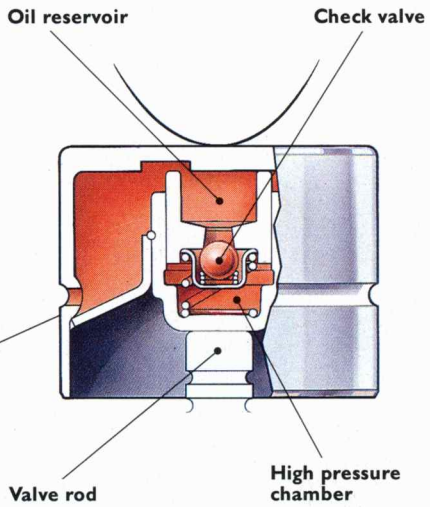
Double overhead camshafts with automatic chain tensioner.

Self-adjusting hydraulic lifters

Since the hydraulic lifters of the Saab 16-valve engine are self-adjusting, periodic adjustment of the valve clearances is not necessary. This simplifies service work and reduces service costs. Since the valve clearances are always correct, engine wear will be reduced. Valve noise will be lower, and the engine will run silently and smoothly. Patent applications have been filed for certain parts of the hydraulic lifters.

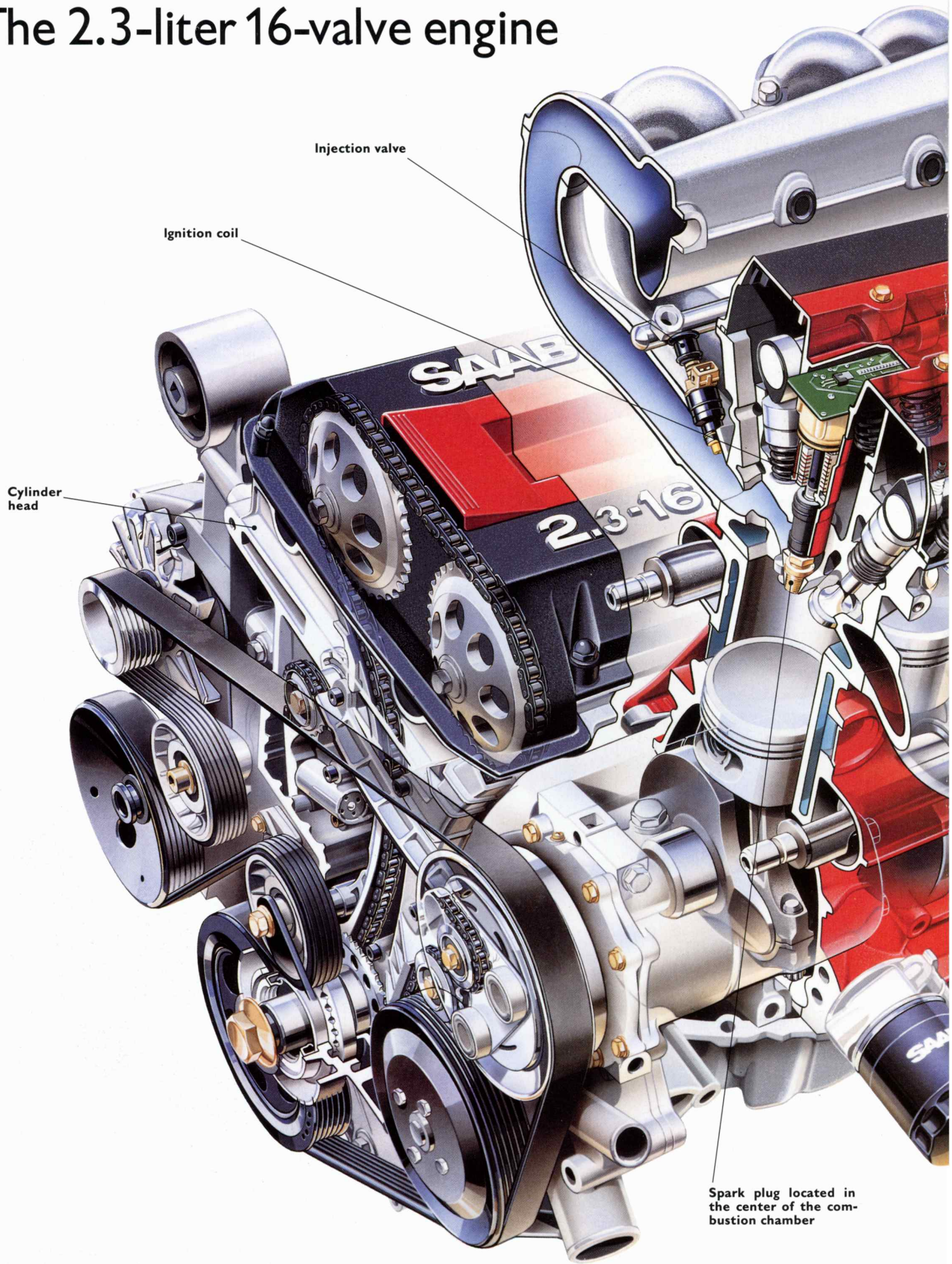


The combustion chambers of the Saab 16-valve engine are, with their dome-shape and centrally placed spark plug, ideally designed for optimum power and combustion. The bottom of the combustion chamber is formed by the piston crown.

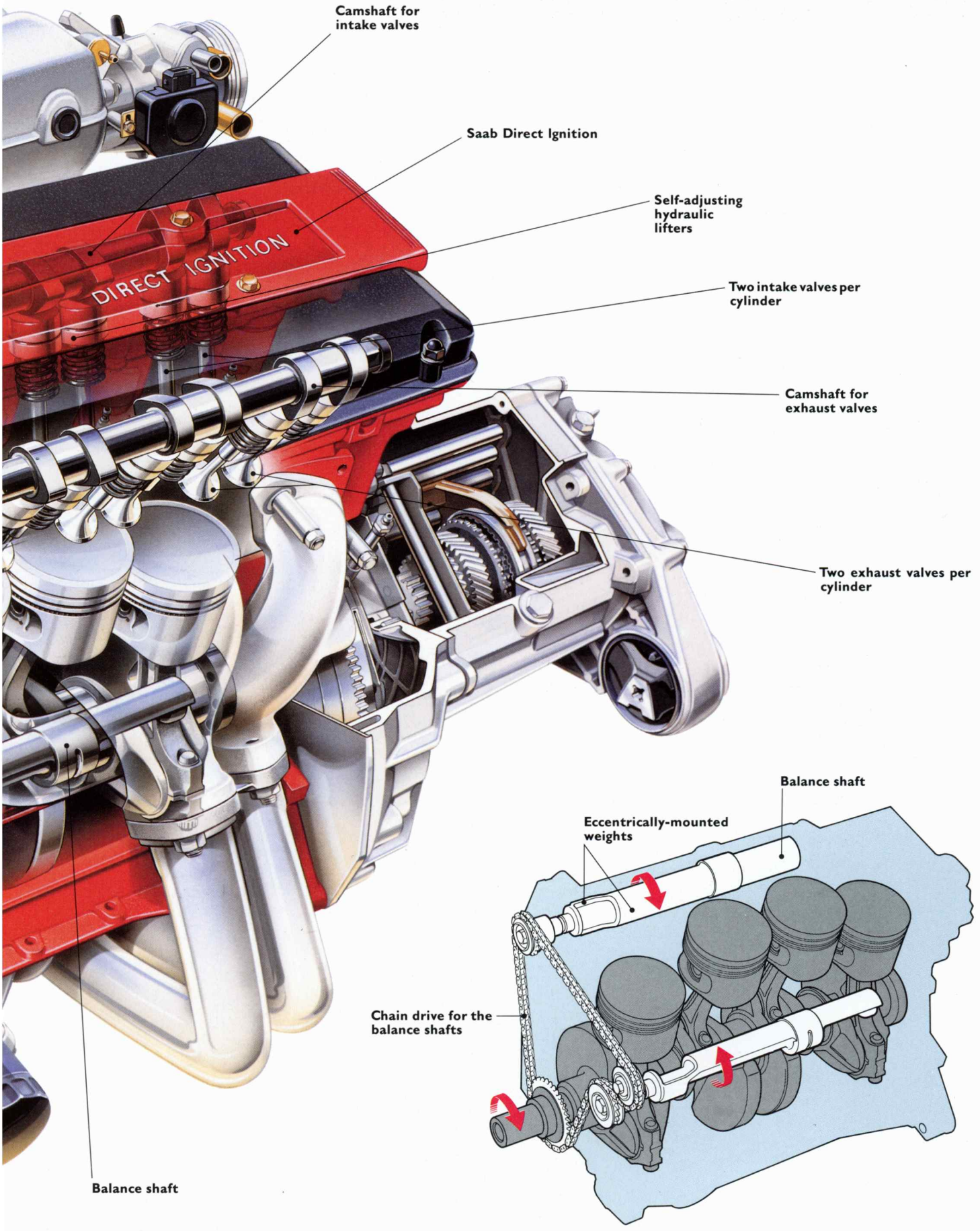


The hydraulic lifters of the Saab 16-valve engine require no maintenance. The valve clearances are adjusted automatically. Oil flow continually adjusts for optimum lifter play with valve.

The 2.3-liter 16-valve engine



The new 16-valve engine displaces 2.3 liters.



The two balance shafts give the 2.3-liter engine virtually vibration-free operation. The balance shafts are chain-driven at twice the crankshaft speed, and carry eccentrically-mounted weights, which create forces that level the vibrations of the engine.

The Saab 2.3-liter engine is the base of a new generation of 4-cylinder engines with balance shafts. The engine is equipped with the Saab Direct Ignition system and other innovative design features that characterize Saab 16-valve engines. It represents the state of the art in four-cylinder engine technology.

The 2.3-liter engine

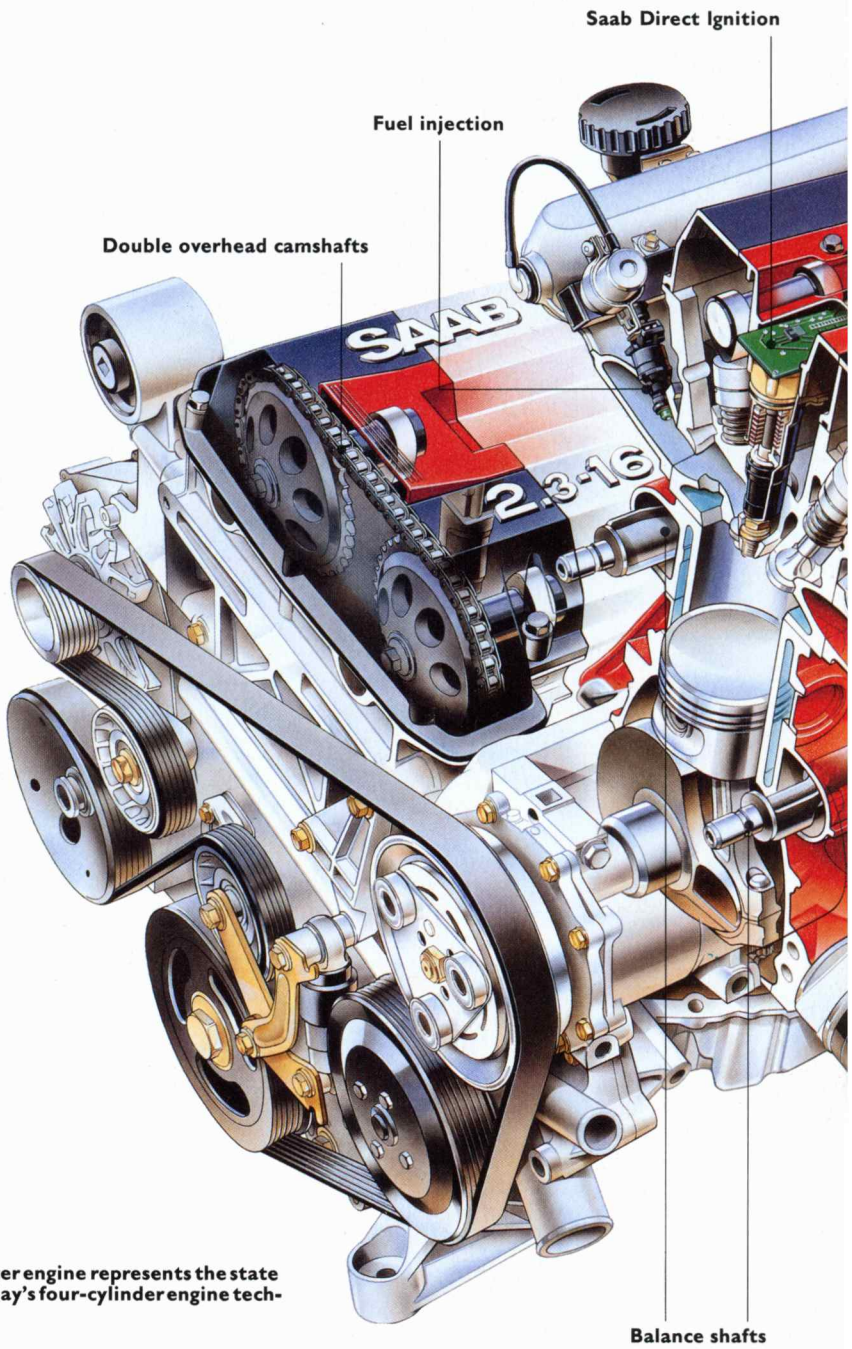
The Saab 2.3-liter engine offers a level of driving enjoyment comparable to that of many multi-cylinder engines of larger displacement. The engine incorporates counter rotating balance shafts, and the intake air system is designed for high torque at low engine speeds.

Virtually vibration-free

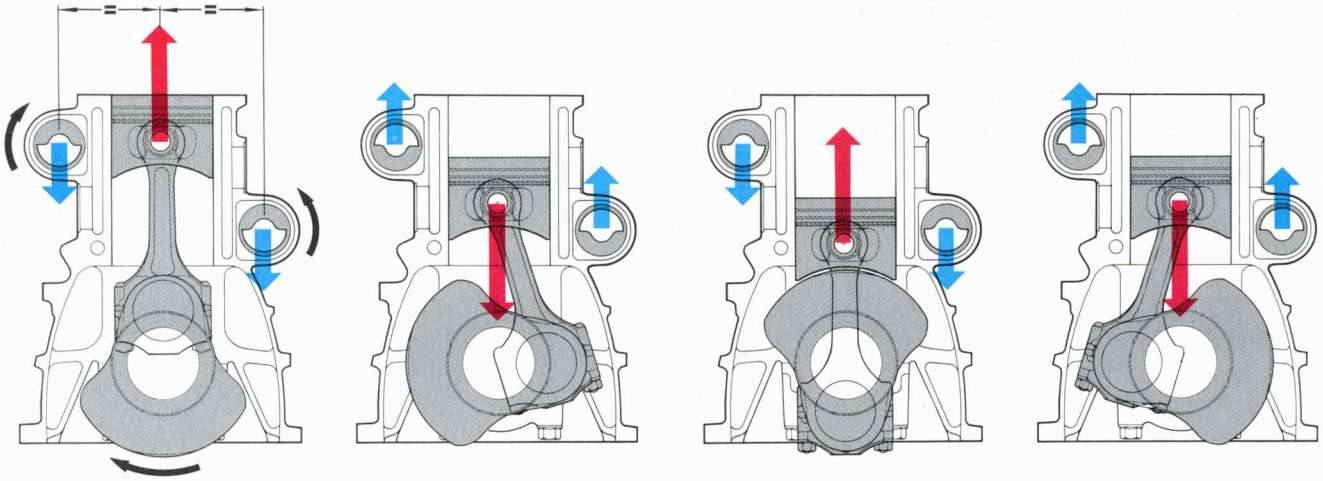
When an in-line, 4-cylinder engine is running, one pair of pistons is on the upward stroke while the other pair is travelling downwards. The two piston pairs cannot balance out one another perfectly. Due to the geometry of the crankshaft mechanism, the two pairs of pistons travel at somewhat different speeds as they approach their reversal positions. To compensate for the resulting forces, the 2.3-liter engine is equipped with counter rotating balance shafts.

The balance shafts are driven by a chain and rotate at twice the crankshaft speed. Weights that are eccentrically mounted on the balance shafts counteract and smooth out the vibrations caused by the reciprocating pistons and connecting rods. The result is a smooth, virtually vibration-free engine.

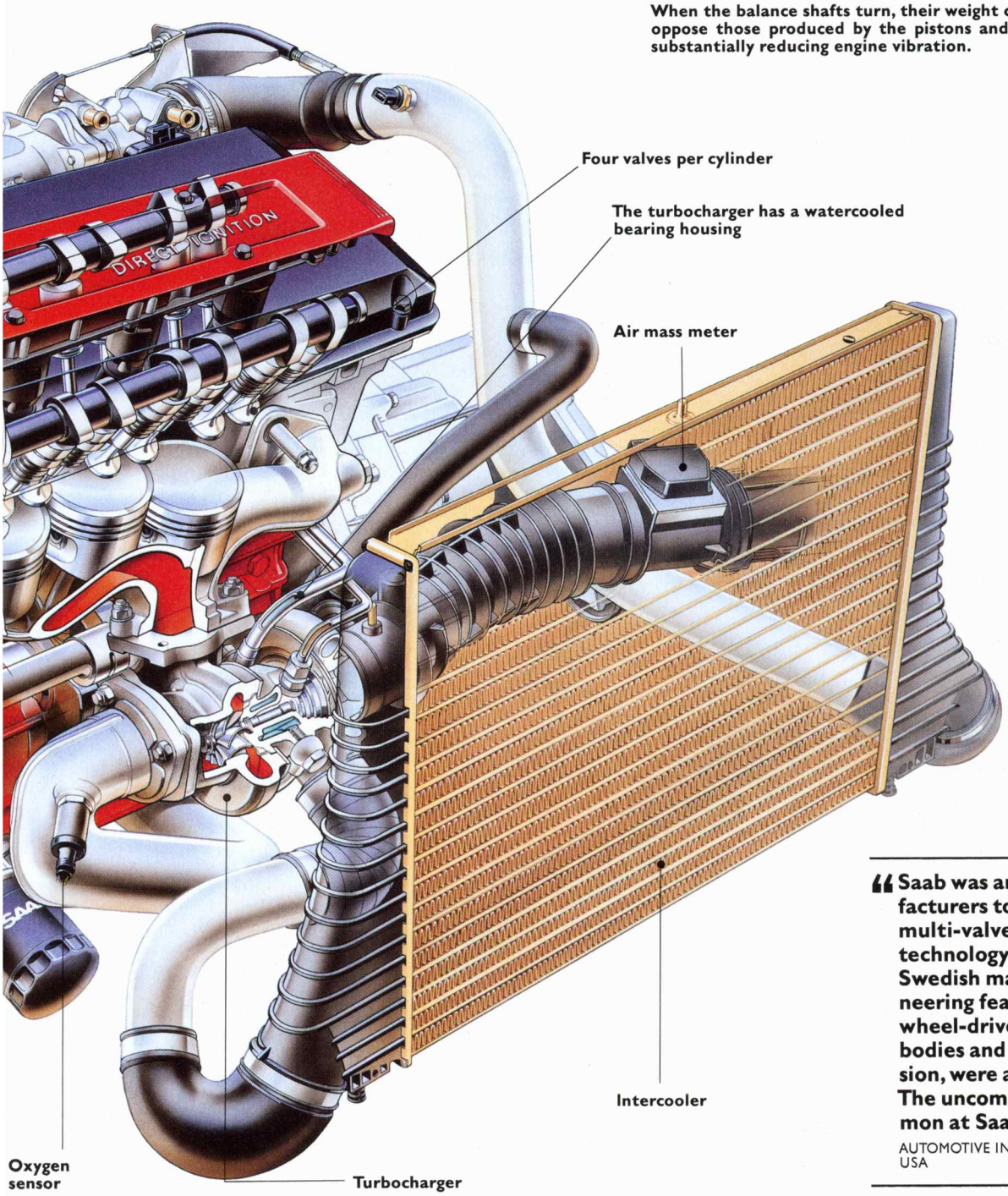
The Saab 2.3-liter engine represents the state of the art in today's four-cylinder engine technology. Its power is as impressive as its smoothness.



The Saab 2.3-liter engine represents the state of the art in today's four-cylinder engine technology.



When the balance shafts turn, their weight creates forces that directly oppose those produced by the pistons and connecting rods, thereby substantially reducing engine vibration.



"Saab was among the first manufacturers to present practical multi-valve and turbocharging technology. Many of the plucky Swedish make's innovative engineering features, including front-wheel-drive, free-wheeling, unit bodies and torsion bar suspension, were ahead of their time. The uncommon was always common at Saab."

AUTOMOTIVE INDUSTRIES
USA

The turbocharging system induces the lightweight and economical Saab 16-valve engine to deliver the power of a more complicated engine with larger displacement.

The turbocharging system

The Saab turbocharging system consists principally of a turbocharger, an intercooler and the APC system. The turbocharger uses the exhaust gases discharged by the engine to drive a compressor which, when extra power is needed, delivers more air to the engine. Since the Saab turbocharger has small rotating masses, it can start to function at very low engine speeds. At only 1500 rpm, for example, it increases engine torque by as much as 20%, and at 3000 rpm the engine develops maximum torque. This means that there is substantial reserve power when overtaking—even without downshifting. The turbocharger gives the four-cylinder Saab engine performance equivalent to that delivered by many, much larger "sixes" and "eights."

The turbocharger has a water-cooled bearing housing—a feature that prevents overheating and carbonizing of the lubricating oil when the engine is switched off and oil circulation stops.

During normal driving, the

Working principles

Let us follow the air on its path through the turbo engine—from the moment it is drawn in until it is exhausted.

1. The air is drawn in here. It passes through a filter and an air mass flowmeter.

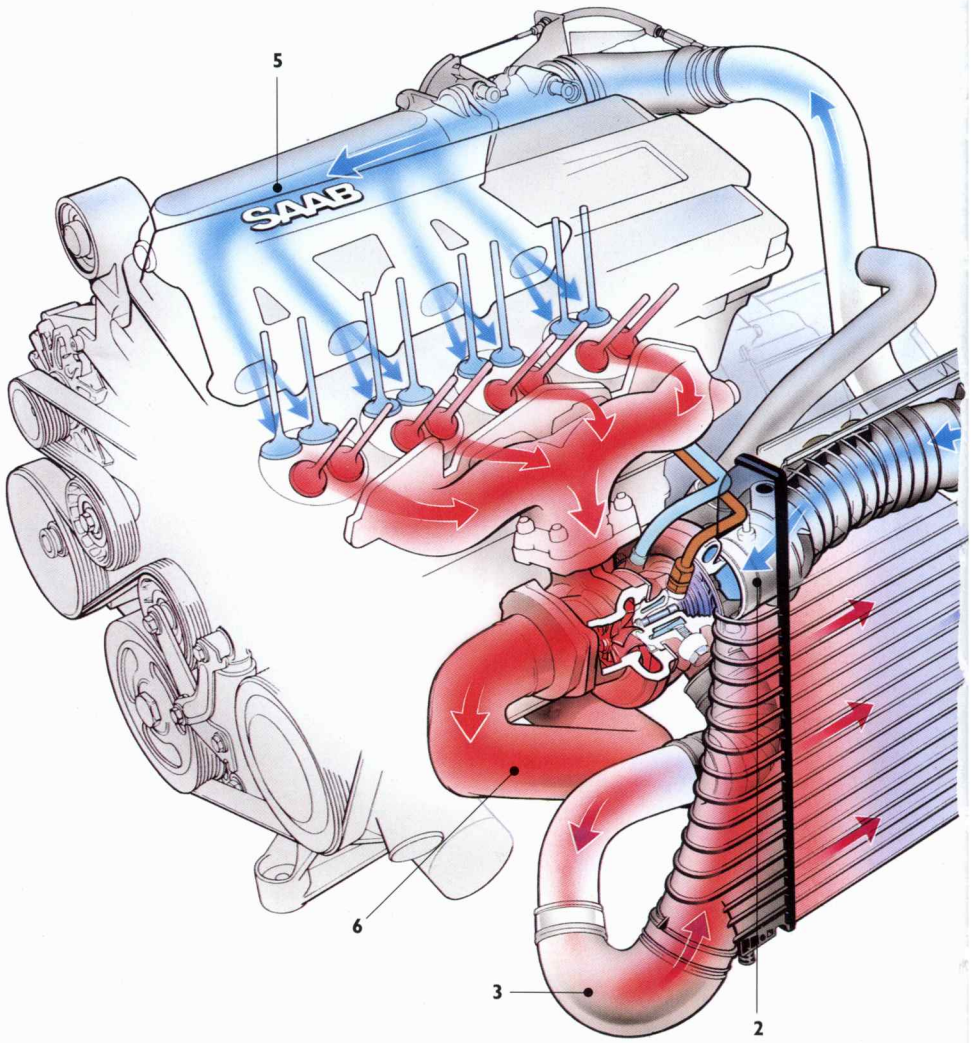
2. The air reaches the compressor turbine, which is driven by the exhaust-gas turbine on the same shaft. The air is compressed and its temperature rises.

3. When the air enters the intercooler, it can be as hot as 250°F (120°C).

4. The air leaves the intercooler here; is has been cooled down at least to 140°F (60°C). Since its volume has been reduced by cooling, a larger mass of air (and fuel) can be fed for combustion to each cylinder. Thus the intercooler increases the engine power significantly.

5. Now the air has reached the inlet manifold, where it is distributed to the cylinders.

6. After combustion, the hot exhaust gases are forced out. On their way, they flow through the turbine that drives the turbo compressor. Low engine speed and a small throttle opening mean low exhaust flow. With more throttle, the exhaust flow increases, the turbine spins faster and the turbocharging system starts to function.



turbocharger is used only 15–20% of the time. For 80–85% of the time, the engine operates identically to a conventional naturally-aspirated engine and has the same low fuel consumption.

Intercooler

The colder a given amount of air (at constant pressure), the smaller its volume. Therefore cooling the intake air in the intercooler makes it possible to feed more air into each cylinder. With the introduction of correspondingly more fuel, the combustion power, and thus the total engine power, increases too. The intercooler is mounted ahead of the normal radiator.

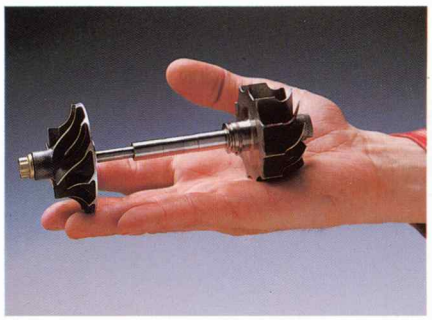
The APC system

The Automatic Performance Control (APC) designed and patented by Saab yields substantial torque and excellent fuel economy; it also allows the engine to run on fuel of any octane rating of 87 AON and above.

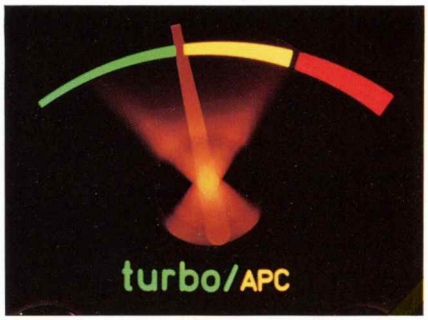
The APC system controls the boost pressure of the turbo to keep it at the optimum operating level for every driving situation. To obtain the highest output and fuel efficiency, the boost pressure is maintained as high as possible without producing engine knocking. The "knock limit" is determined by engine speed, load, temperature and fuel octane. The APC system always optimizes the boost pressure and eliminates the risk of harmful knocking.

The APC system enables the Saab engine to operate at a higher compression ratio than conventional gasoline-powered engines. It therefore makes a major contribution to fuel economy. It also gives Saab turbo engines the advantage of running on relatively low-octane fuel if desired, or using higher-octane fuel for greater power.

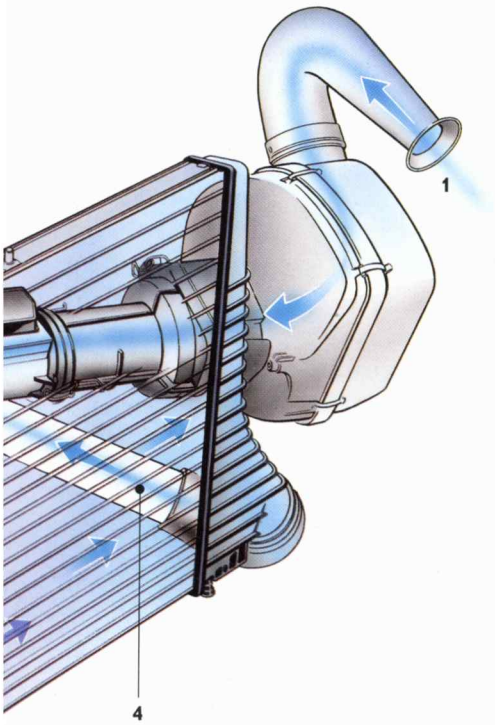
"Saabs boast a unique combination of performance, safety, practicality and value."
AUTOMOTIVE INDUSTRIES
USA



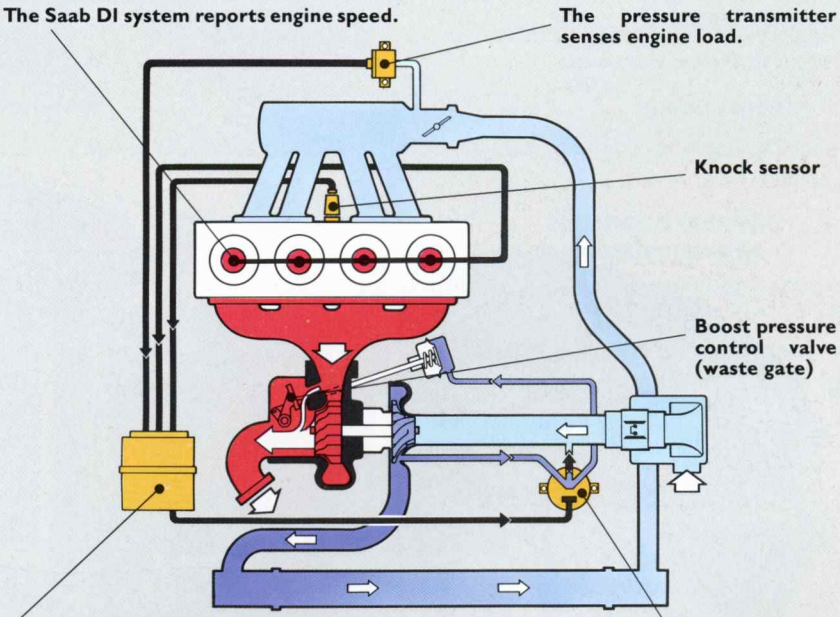
The Saab turbocharger has small rotating masses, for fast response and turbocharging from the lowest engine speeds upwards.



The boost pressure gauge in the instrument panel allows the driver to monitor turbo operation at all times.



How the APC controls turbo boost pressure.


The Saab DI system reports engine speed.
The pressure transmitter senses engine load.
Knock sensor
Boost pressure control valve (waste gate)
Solenoid valve

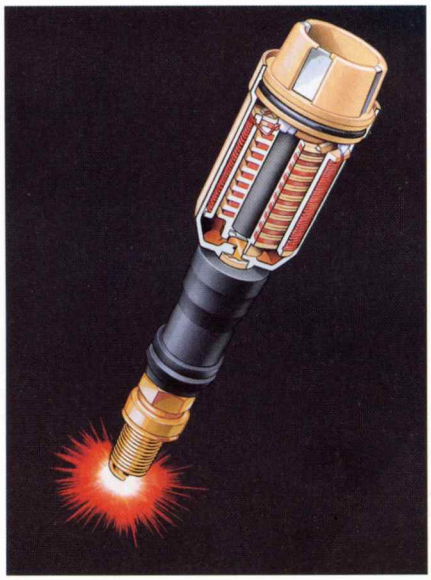
The APC control unit receives load and speed data. When knocking is detected by the knock sensor, the control unit sends a signal to the solenoid valve that operates the boost pressure control valve. This procedure reduces the boost pressure until knocking stops.

Saab Direct Ignition is yet another example of Saab's innovative technology. As a result, you get reliable all-weather starting, lower maintenance costs and lower fuel consumption.

Saab Direct Ignition

All 1991 Saab 9000's are equipped with Saab Direct Ignition (Saab DI).

The Saab DI system is a capacitive ignition system that has no moving parts. The ignition timing is permanently preset at the factory. This ensures reliable starting in any weather—and minimizes the service costs.



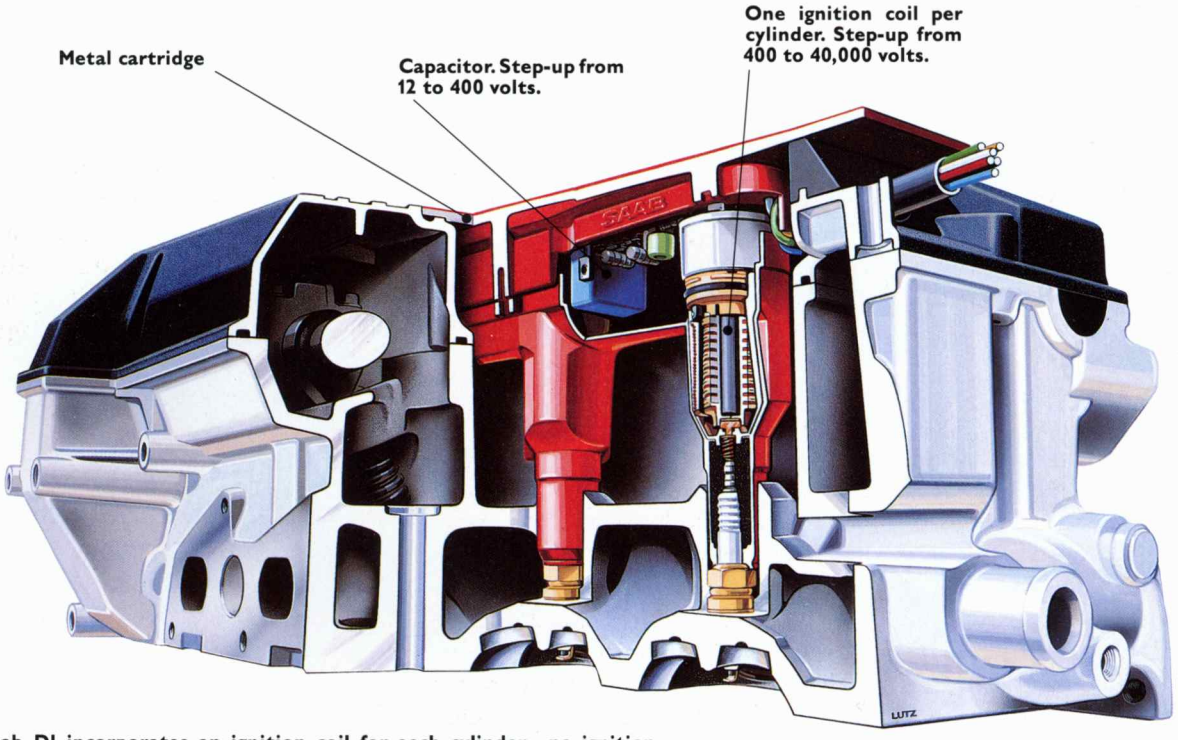
Reliable starting

Damp weather and low temperatures can make a car difficult to start. The Saab Direct Ignition system combats these problems.

The Saab DI system has no high-tension leads and no distributor cap, both of which can provide a current leakage path along a film of moisture. In the Saab DI system, an ignition coil is mounted directly on each spark plug to ensure optimum spark.

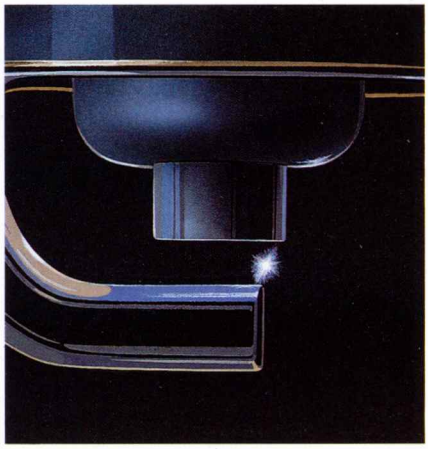
In extremely cold weather, the Saab Direct Ignition system offers additional security. It generates an ignition voltage of 40,000 volts, instead of the 25,000 volts delivered by a conventional ignition system. Even if the battery voltage is low, the Saab DI system will still fire a strong spark.

The high voltage is generated in two stages. In the first stage, 12 volts is stepped up to 400 volts by capacitive charging. In the second stage, the 400 volts is

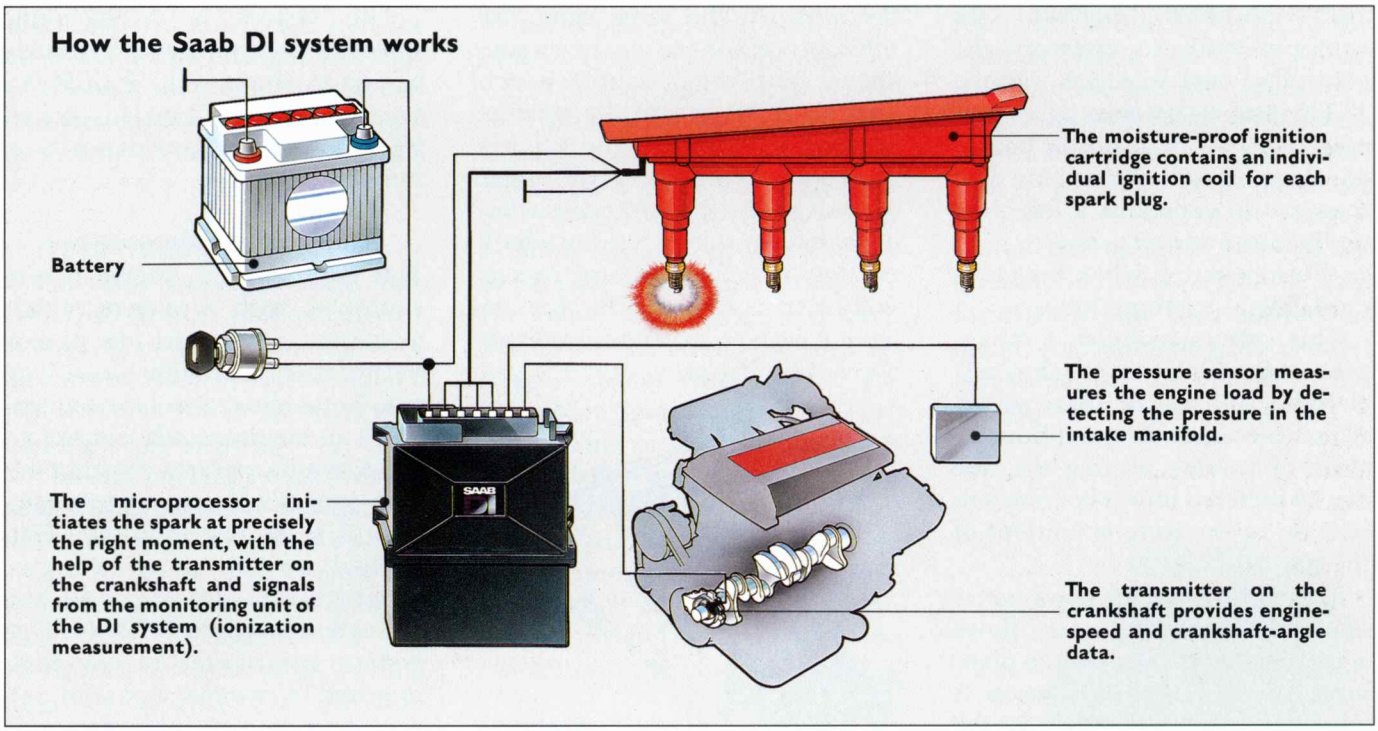

Metal cartridge
Capacitor. Step-up from 12 to 400 volts.
One ignition coil per cylinder. Step-up from 400 to 40,000 volts.
SAAB
LUTZ

Saab DI incorporates an ignition coil for each cylinder—no ignition cables, no distributor. The ignition system is encapsulated in a sealed metal cassette, protected from moisture and dirt.

Thanks to the short charging time, when the engine is started, Saab DI can fire off a series of sparks ...



... instead of just one.


How the Saab DI system works
Battery
The moisture-proof ignition cartridge contains an individual ignition coil for each spark plug.
The pressure sensor measures the engine load by detecting the pressure in the intake manifold.
The microprocessor initiates the spark at precisely the right moment, with the help of the transmitter on the crankshaft and signals from the monitoring unit of the DI system (ionization measurement).
The transmitter on the crankshaft provides engine-speed and crankshaft-angle data.
SAAB

stepped up to 40,000 volts in the four ignition coils—one on each spark plug.

Since the ignition coils step up the voltage "only" 100-fold (as compared to the 2,000-fold step-up in a conventional ignition system), the Saab DI coils are so small that they can be mounted in a cartridge immediately above the spark plugs. The cartridge provides effective protection against moisture and dirt.

Multi-spark

Another advantage of Saab DI is very rapid spark generation. Charging is twenty times faster than in a conventional system. As well as providing a good spark at high engine speeds, this allows a whole burst of sparks to be produced instead of a single one, e.g. when starting a cold engine. We call this "multi-spark". This burst of sparks effectively burns off any carbon deposits or fuel residue on the spark plug electrodes, providing quick, sure starting.

If the engine should, for some reason, fail to start at the first attempt, Saab DI brings a further feature into play. When the ignition key is released from the starting position, the system produces a massive stream of approximately 1,000 sparks—on all cylinders at once—to ensure that even the heaviest deposits have been burned off.

Reduced service requirements

Saab DI has no moving parts, and the timing is set once and for all at the factory, thus minimizing service costs. The mechanical ignition distributor is eliminated.

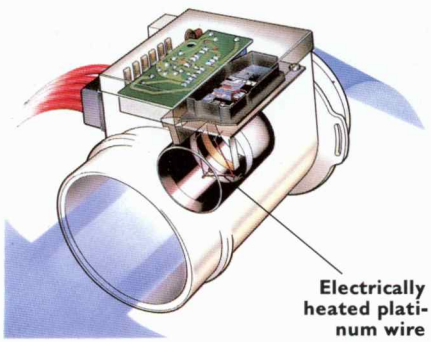
Fuel injection enables the fuel/air ratio to be controlled very accurately, which contributes to high power, low fuel consumption, smooth running and low exhaust gas emissions under a wide variety of motoring conditions.

Fuel injection

Saab 16-valve engines are equipped with an electronically controlled fuel injection system. The system makes the engine very easy to start—be it hot or cold—and also makes the engine less sensitive to variations in ambient temperature and air pressure, such as those occuring when the car is travelling at varying altitudes.

This system includes a microprocessor which controls the fuel/air ratio, and an air mass meter, which measures air mass flow instead of volume, so that the fuel can be metered more accurately in relation to the oxygen content of the air.

This is how the air mass meter operates. Incoming air flows across an electrically heated platinum wire in a tubular air meter. A microprocessor measures the electrical energy necessary to maintain the wire at a constant temperature, which is a measure of the mass of air flowing across the wire. At the same time, the microprocessor senses the engine speed and temperature, which enables it to meter the correct quantity of fuel to suit the requirements of the engine at all times. Moreover, the microprocessor incorporates a speed limiter which ensures that no opening signals will be transmitted to the fuel injection valves at engine speeds above 6000 rpm.



The LH Jetronic air mass meter makes the engine insensitive to variations in ambient air temperature and pressure. The air meter has no moving parts to wear out.

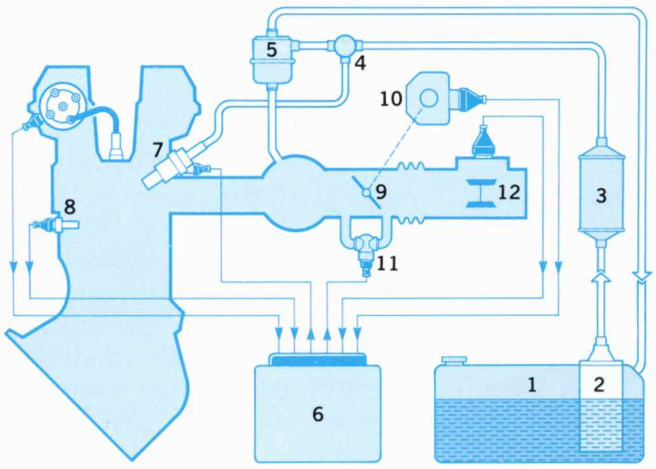
The system is self-cleaning, since the platinum wire is quickly heated to about 1800°F (1000°C) every time the ignition is switched off. This burns off any deposits on the wire.

Automatic idle control

The Saab 16-valve engine is also equipped with a system which maintains a constant idle speed, regardless of the engine load. The automatic idle control system employs an electronically controlled valve, which ensures that the engine speed will remain constant, regardless of any additional load applied by the air conditioner, automatic transmission or electric defroster for the rear window. This system contributes to the high standard of comfort and is of particular benefit to the driver. It ensures constant idle at high altitude areas and aids improved fuel economy.

How the fuel injection system works

The intake manifold is equipped with one injection valve for every cylinder. The injection valve is fitted upstream of the corresponding intake valve and is controlled electro-magnetically by signals from the electronic control unit. The control unit calculates the opening time for the injection valve to suit the engine running conditions, so that the quantity of fuel injected will be correct in relation to the quantity of air flowing to the engine.



Fuel system

1. Fuel tank
2. Fuel pump
3. Fuel filter
4. Fuel distribution
5. Pressure controller
6. Electronic control unit
7. Injection valve
8. Temperature sensor
9. Throttle valve
10. Throttle valve switch
11. Idling valve
12. Air mass meter

Every Saab 9000 is equipped with a catalytic converter, which converts the majority of harmful exhaust emissions to non-toxic gases such as nitrogen, carbon dioxide and steam.

The exhaust emission control system

The catalytic converter reduces nitric oxide into nitrogen and oxygen, which then oxidizes the carbon monoxide and unburned hydrocarbons to carbon dioxide and water.

Fuel Injection System

If the three-way conversion described above is to proceed effectively, fuel / air mixture must always be correct. Therefore, the catalytic converter needs a sophisticated fuel metering system.

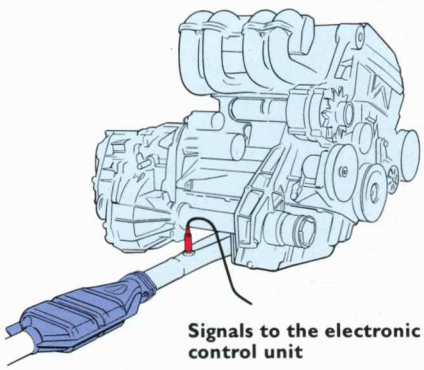
The fuel injection system in the Saab 9000 measures the mass of the incoming air. It takes into account air and engine temperatures, engine speed and engine load. All data are monitored by the electronic control unit, which then commands the injection valves (one for each cylinder) to open for the precise time required to inject just the right amount of fuel for optimum combustion.

Closed-Loop System

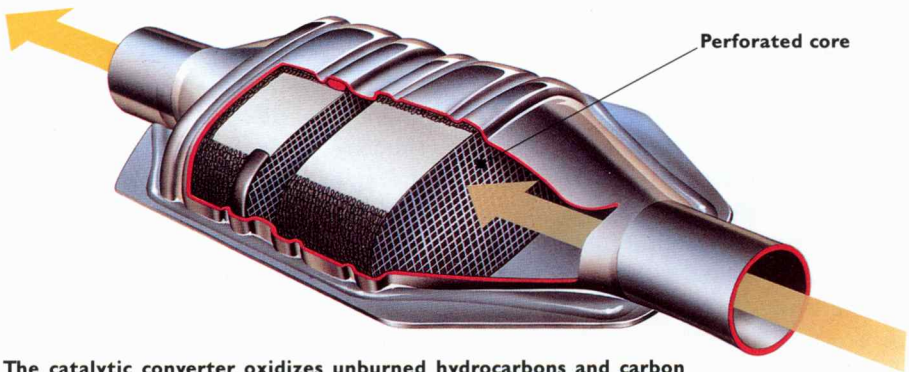
Optimum catalytic converter efficiency takes place when the engine's air/fuel ratio is maintained at a chemically correct value, known as Lambda = 1. To control the air/fuel ratio for Lambda = 1, each Saab 9000 is equipped with an oxygen sensor fitted in the exhaust pipe upstream from the converter. This sensor provides feedback information to a control unit which adjusts the amount of fuel injected accordingly. The closed-loop system assures that the correct air/fuel ratio which is essential for proper operation of the converter is always maintained.

Catalytic Converter

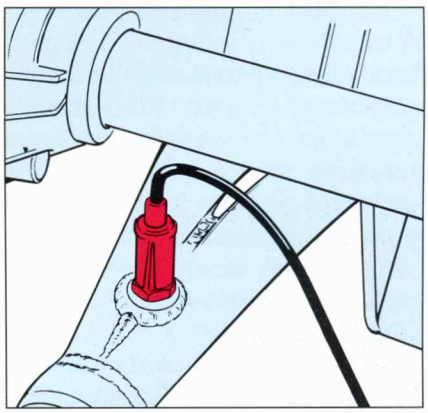
Externally, the catalytic converter resembles a muffler fitted to the exhaust system beneath the floor. Inside it houses two ceramic honeycombs with large surface areas coated with precious metals (principally platinum and rhodium). Cars fitted with catalytic converters must be operated with unleaded fuel; otherwise, a layer of lead forms above the layer of precious metal, contaminating the catalyst and impairing the emission conversion efficiency.



Signals to the electronic control unit



The catalytic converter oxidizes unburned hydrocarbons and carbon monoxide and reduces nitrogen oxides from the exhaust gases. The majority of these harmful gases is converted into carbon dioxide, nitrogen and steam.



The electronic control unit receives information about the chemical composition of the exhaust gases from the oxygen sensor fitted in the exhaust pipe.

Highly efficient, lightweight, easy to use, compact, durable and easy to service. These are the main characteristics of the gearboxes fitted to the Saab 9000.

Transmission

The function of the gearbox is to transmit the engine power to the wheels as efficiently as possible. It must not waste power and must be easy to use. In addition, the gearbox must contribute towards low fuel consumption by enabling appropriate reduction ratios to be selected—either automatically or manually, depending on the type.

This has been the basis for the design work on the Saab 9000 gearboxes. As a result, they are lightweight, compact and highly efficient.

Saab's four-cylinder engine, with its low internal friction, allows gear ratios to be chosen for more lively performance than is usually provided by cars with bigger engines—yet fuel economy is maintained. This advantage proves particularly valuable in hill country.

Transversely-mounted, pre-assembled gearbox

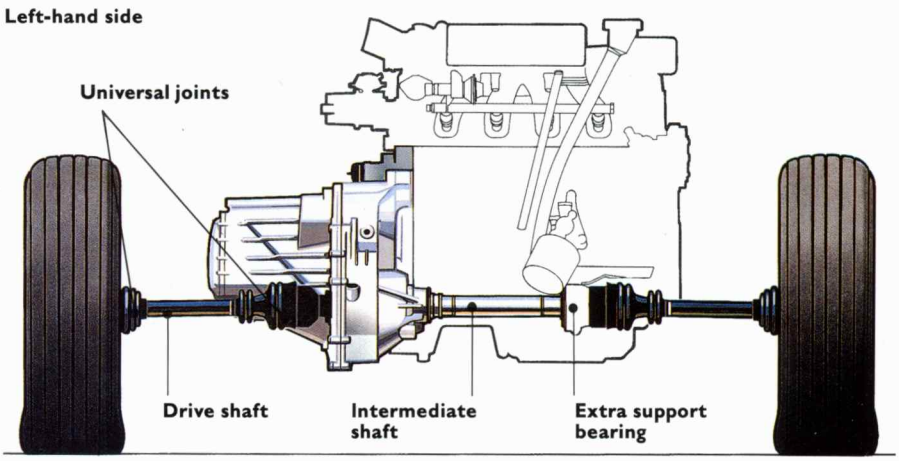
The integrated power unit—comprising the engine and gearbox—is transversely mounted. The gearbox is located to the left in the engine compartment. By mounting the engine transversely, the power transmission line between the engine and gearbox is straight, and power is transmitted to the driven wheels along the shortest possible path, thus minimizing power losses.

The gearbox is compact, with the final drive and differential integrated into the gearcase. The manual gearbox weighs no more than 93 lb (42 kg), and the automatic transmission weighs 172 lb (78 kg).

As opposed to many other cars with front-wheel drive and with the power unit mounted transversely, the Saab 9000 does not pull to one side when accelerating. This absence of "torque steer" has been achieved by both drive shafts being of exactly the same length and by appropriate geometry of the front suspension. The drive shafts are thus always at the same angle in relation to the wheels. The design incorporates an extra support bearing for the right-hand drive shaft, which is connected to the differential by a short, torsionally rigid shaft.

The drive shafts and universal joints are permanently lubricated and are designed for a very long life cycle. The universal joints are designed to ensure smooth transmission of power, regardless of the wheel angles.

The gearbox, together with the engine, front suspension and the radiator assembly, is pre-assembled on a split subframe. As a result, the gearbox is easily accessible for service, without the need for removing the engine from the car.

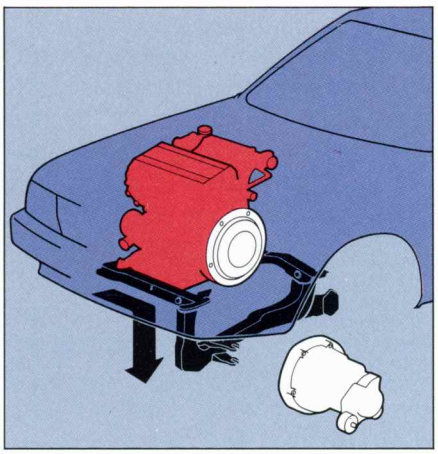


The extra intermediate shaft and the support bearing allow both drive shafts to be of equal length. This means that the Saab 9000 does not pull to one side during extreme acceleration.

Manual gearbox

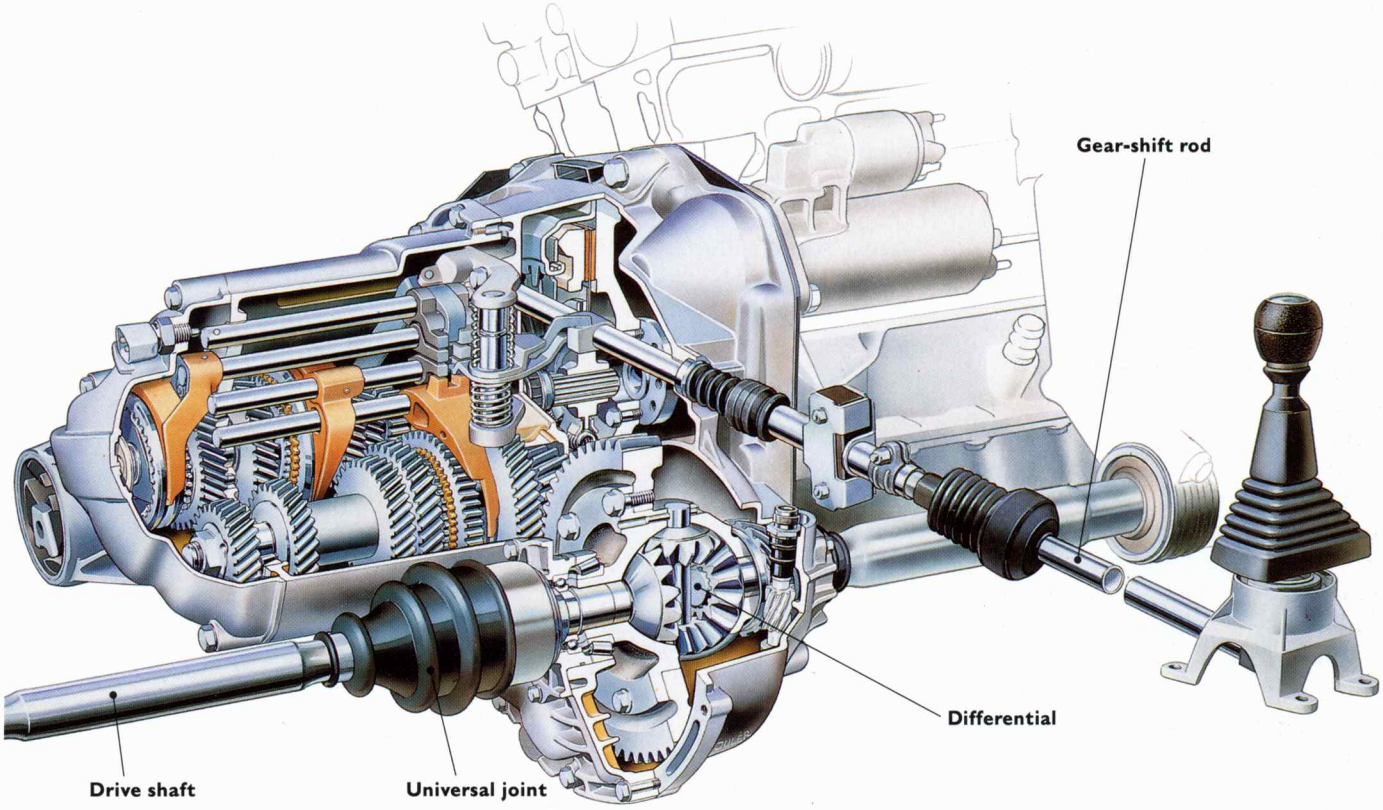
The five-speed manual gearbox is of simple design and has small rotating masses, which minimize the gear-shifting effort. It is designed to transmit very high power and torque, with ample margins of safety. The fifth gear ratio has been specified to ensure optimum fuel economy—but without impairing the drivability.

Gear-shifting is easy due to the favorable locations of the synchromesh mechanisms. Due to the



Because of the hinged and split subframe, the gearbox can be dismantled without lifting the engine out.

Saab engines develop high torque even at low speeds so gear-shifting can be reduced to a minimum.



The five-speed manual gearbox is integrated with the differential. Together they make up a light, compact unit.

strategic locations of tapered roller bearings, the shafts have high stiffness under load.

The gearcase of the manual gearbox has only two joint faces, and all unnecessary covers and connections have been eliminated, to provide good sealing. A special oil supply system limits the friction by maintaining a low oil level and makes gear-shifting easy, even when starting from cold.

The gear-shift mechanism is contained inside the gearbox itself, so it is always well lubricated. The gear-shift rod enters the gearbox at the point around which the gearbox moves when the engine accelerates or decelerates. As a result, the gear lever travel is short and distinct. The only part of the gear-shift mechanism that projects outside the gearbox is a long, straight rod, fitted with a rubber joint and a universal joint to minimize the sound transmission to the interior.

The gear lever is spring-loaded to the 3rd/4th gates and is thus automatically centered in neutral, to ensure that the driver will never be in doubt as to the actual position of the gear lever. The pattern of gear-shifting is designed so that reverse gear cannot be engaged by mistake. Reverse gear is protected with a collar and has a separate gate to the right of the 5th gear gate.

Automatic transmission

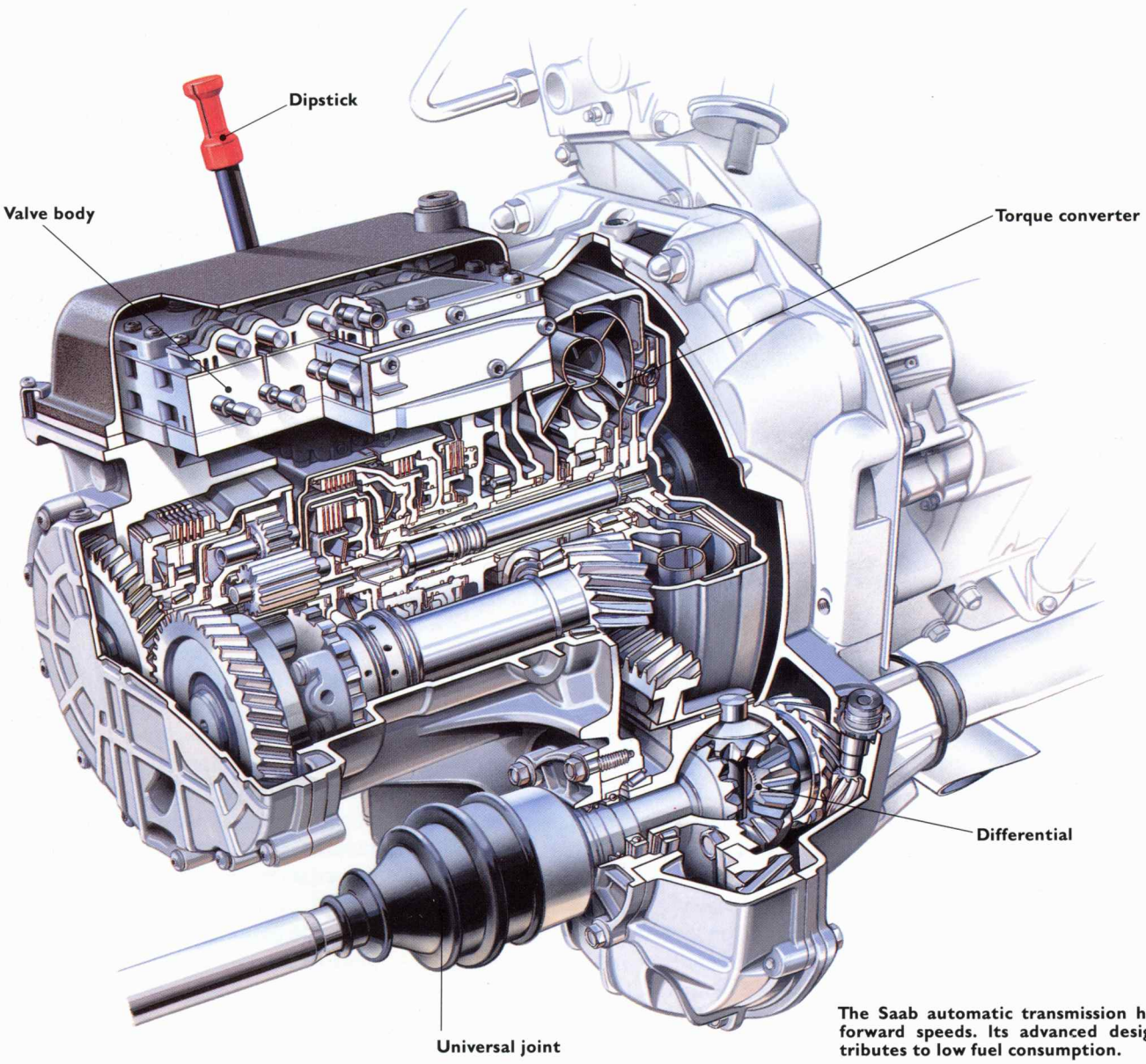
The automatic transmission devel-

oped for the Saab 9000 is a four-speed design. Third gear features split-torque transmission, and direct drive is employed in fourth gear. In the split-torque third gear, 39% of the power is transmitted through the torque converter, and the remainder is transmitted mechanically. The direct drive function in fourth gear by-passes the torque converter, and the drive is purely mechanical. This minimizes power loss and lowers sound level, in addition to improving performance and reducing fuel consumption.

As compared to automatic transmissions of other manufacturers, the four-speed Saab unit is extremely compact and lightweight. As in the case of the manual gearbox, the automatic transmission can be removed from the car separately, by lowering the split subframe.

The gear-shift lever is of correct ergonomic design with clear position indicator.

The selector lever is of ergonomic design, is correctly angled towards the driver and offers a firm grip. On cars with manual transmissions the gear-shift pattern is displayed on top of the shift knob. On automatic transmission-equipped vehicles, the gear indicator is located beside the gear-shift and is clearly illuminated from the inside of the console. The gear selected is also clearly indicated by the Electronic Display Unit (EDU) within the instrument panel in front of the driver.



The Saab automatic transmission has four forward speeds. Its advanced design contributes to low fuel consumption.

Performance

Four-cylinder engine with double overhead camshafts (DOHC), 16-valves and dome-shaped combustion chambers:
- High power.
- Low fuel consumption.
- Limited service requirements.
- High reliability.
- Efficient combustion—cleaner exhaust gases.

Turbocharging with intercooler:
- Offers the same acceleration and top speed as many six-cylinder or eight-cylinder engines but with lower fuel consumption.
- Favorable working temperature—for better resistance to wear and longer useful life.
- High reliability.

Self-adjusting hydraulic lifters:
- Highly reliable—limited service requirements.
- Reduced noise.
- Increased accuracy.

Microprocessor-based APC system and LH fuel injection:
- The engine can run on fuel of any octane rating (87 AON and above), without adjustment.
- Improved fuel economy.
- High performance, above all on starting and at low speeds.
- High reliability under all conditions.
- Efficient combustion—cleaner exhaust gases.
- Reliable starting, from hot or cold.
- Maintains correct fuel/air ratio at all altitudes.

Saab Direct Ignition:
- Reliable starting in difficult conditions.
- Entirely protected from moisture and dirt.
- No moving parts—no adjustment ever required.
- Long intervals between spark plug replacement.
- Lower servicing costs.

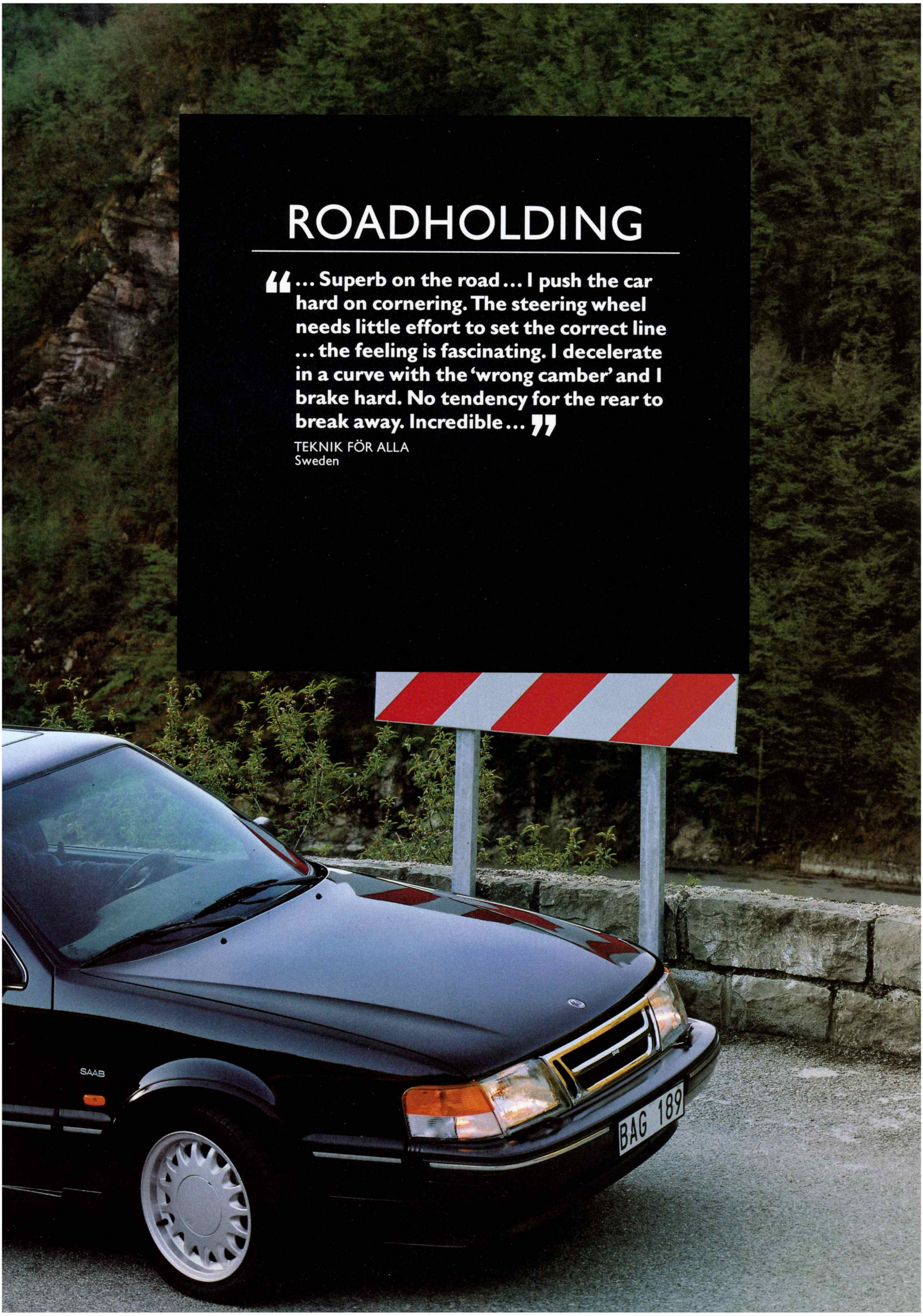
The engine and gearbox are mounted on a hinged, split sub-frame:
- Simplified service work.
- Faster clutch replacement.
- The gearbox is easy to remove.

Transversely mounted gearbox integrated with the engine and differential:
- Compact power unit—limited space requirements.
- Good cooling of the engine and gearbox.
- Effective protection in a collision.

Split torque in third gear of the automatic transmission:
- Saves fuel and lowers sound level.
- Improves performance.

Direct drive in fourth gear of the automatic transmission:
- Direct drive saves fuel and lowers sound level.

Ergonomic design of selector lever, with clear indication of the gear selected:
- Easy to operate.
- Prevents errors.
- Simplifies driving.



ROADHOLDING

"... Superb on the road... I push the car hard on cornering. The steering wheel needs little effort to set the correct line ... the feeling is fascinating. I decelerate in a curve with the 'wrong camber' and I brake hard. No tendency for the rear to break away. Incredible..."

TEKNIK FÖR ALLA
Sweden

The chassis of the Saab 9000 has been designed with the emphasis on sportiness, comfort and safety. It gives the driver fast and accurate feedback, so that he can immediately take the necessary corrective action—often instinctively. This is because the entire chassis—indeed, the entire car—has been built with the focus on the human being.

Chassis

Since the human being is highly sensitive to even the smallest changes in surroundings, but has poor ability in detecting static changes, this situation has been one of our most important starting points in the design of the Saab 9000 chassis. It is vitally important that the car should give the driver immediate feedback—through the seat and steering wheel—on the lateral forces, for instance, acting on the car when it is cornering. It is important for the driver to receive this information as quickly and distinctly as possible. Information on whether or not the car is cornering correctly,

"... Saab continues its quest for the ultimate combination of ride and handling in the 9000 Turbo."
CAR AND DRIVER
U.S.A.

for instance, must be conveyed to the driver in a matter of tenths or hundredths of a second. The difference between a well designed chassis and a dangerous chassis often lies in how these small, almost immeasurable information signals are conveyed to the driver.

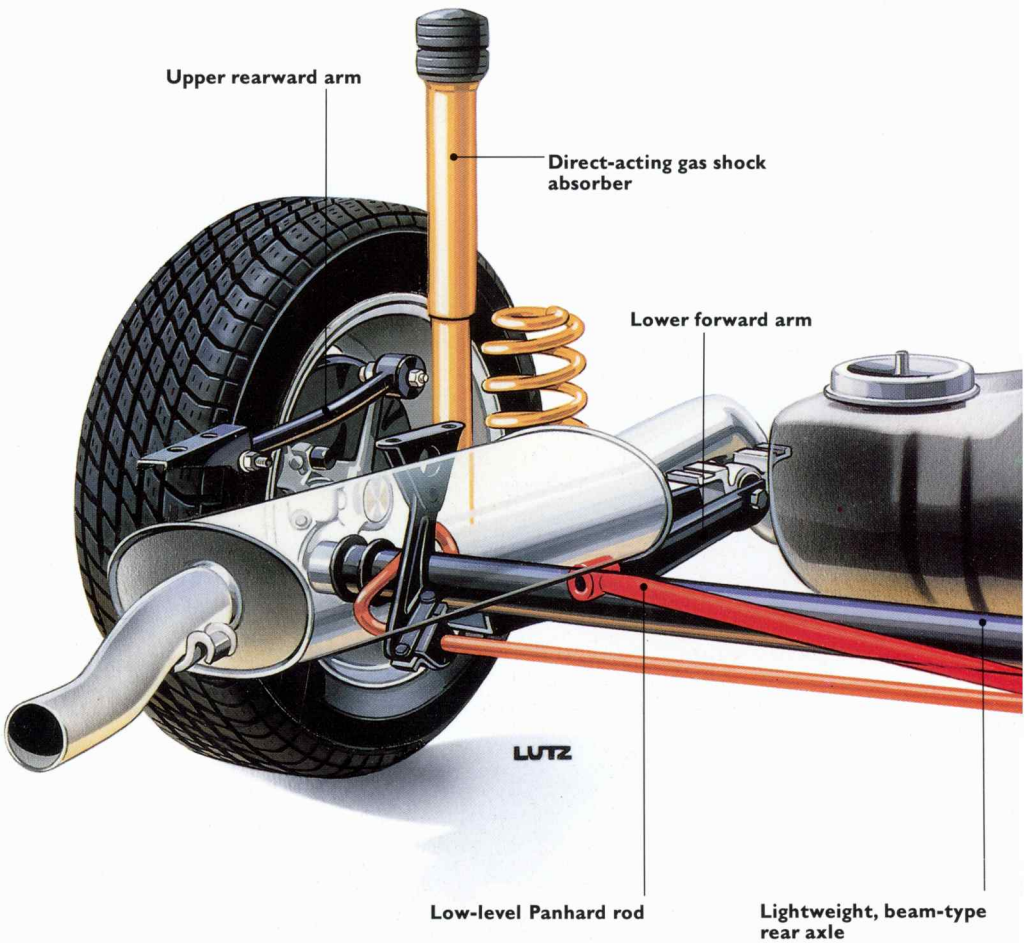
Many car manufacturers describe how computerized methods are used for designing the chassis of their cars. Saab obviously also employs advanced computerized aids for this purpose. But the computer alone is not enough. The human being has been used as the ultimate design and development aid.

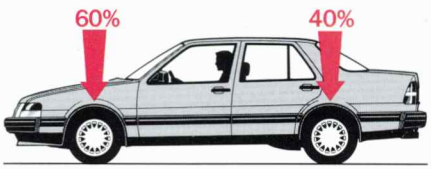
Weight distribution

The weight distribution of the Saab 9000, combined with the chassis geometry, gives excellent roadholding—regardless of the load in the car.

With only the driver aboard, weight in the Saab 9000 CD is distributed 60% on the front wheels and 40% on the rear wheels.

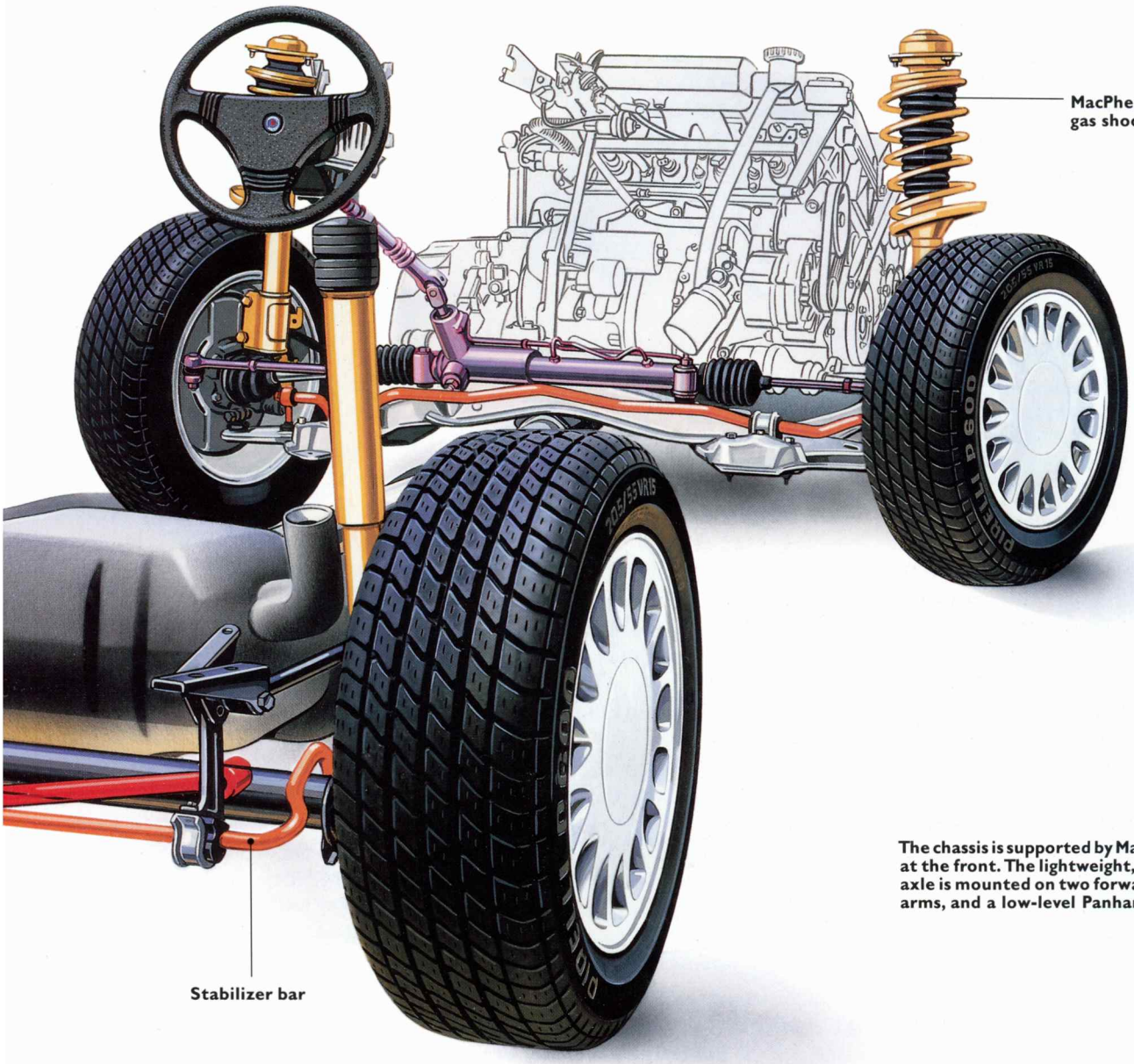
With a full load, the majority of the weight is still positioned above the driven and steered front wheels. This provides excellent roadholding and, most importantly, consistent behavior.





Regardless of the load the majority of the weight is always centered over the driven front wheels. Handling is thus consistent in all situations and the driver is not asked to deal with the unexpected.

Its chassis gives the Saab 9000 the road characteristics of a sports car combined with the ride comfort of a touring sedan.



The chassis is supported by MacPherson struts at the front. The lightweight, beam-type rear axle is mounted on two forward and two rear arms, and a low-level Panhard rod.

Front assembly

The subframe is a vital part of the front assembly. It carries most of the front suspension, as well as the engine, gearbox and radiator assembly. The equipment on the subframe is assembled separately before the entire subframe unit is fitted into the car.

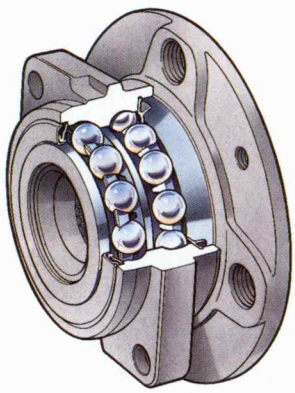
The 9000 is equipped with MacPherson struts. The top mounting of the strut is secured to the body in a conventional manner, but incorporates an end stop of special Saab design. The bottom of the strut is secured directly to the steering knuckle housing. This is a vibration-damping arrangement that also improves durability. The system is simple, robust, reliable and compact, and provides a long spring travel. The long spring travel (7.28 in./185 mm) at the front gives good contact with the road surface, even when the car is driven fast across the brow of a hill or when it is cornering fast. The long spring travel also contributes to a comfortable ride.

The wishbones, stabilizer bar and other chassis components are mounted in well-matched rubber bushings. These provide good road-noise insulation, but are sufficiently firm to give correct "road contact information".

The rear axle design provides a low roll center for minimum roll. It also keeps the track width constant, for optimum road grip.

Integral wheel bearings

The Saab 9000 is equipped with integral wheel bearings which are simple and durable. Conventional wheel bearings require a certain amount of clearance and regular service and lubrication. The new Saab tapered wheel bearings have double races and, after adjustment in production, need no maintenance. The bearings will last the car's lifetime, and the design facilitates the removal of the brake disc.

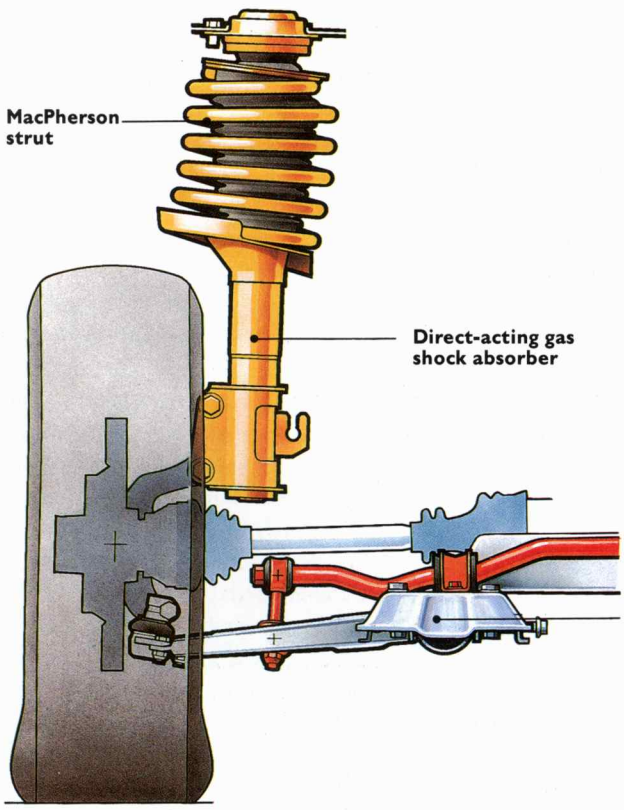


Permanently lubricated, maintenance-free, integral wheel bearings.

Steering

The steering is of rack-and-pinion type and is power-assisted. The number of steering wheel turns lock-to-lock is 3.2. The turning circle diameter is 35 ft 6 in. (10.9 m). The steering wheel has an extra thick rim and is inclined at 28° to the vertical plane, which gives restful seating to drivers of virtually any stature.

The rack-and-pinion design ensures fast and faithful response to the steering wheel. It is highly accurate and has no backlash. The effect of suspension spring deflection on the front wheel angles has

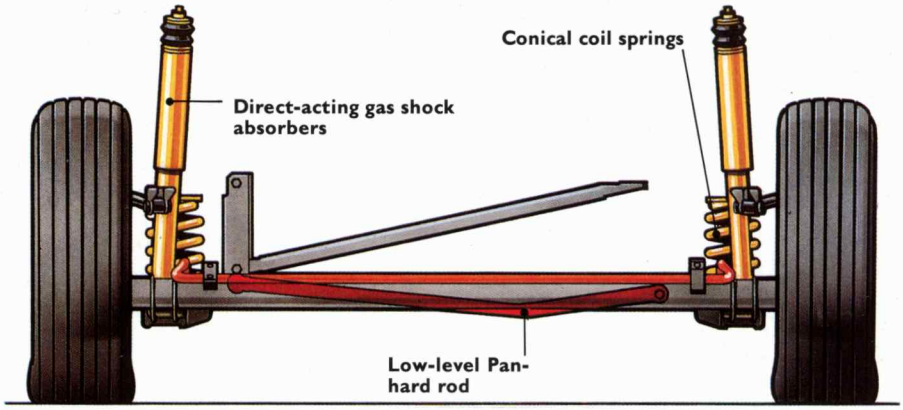


The front assembly provides excellent roadholding characteristics and comfort.

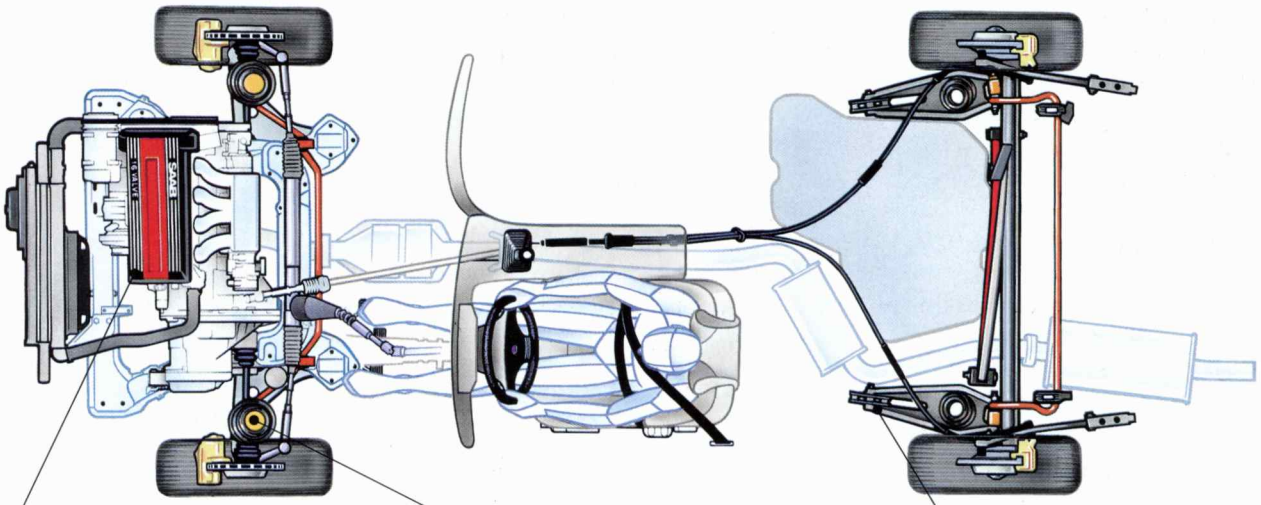
been minimized. The steering gear is permanently lubricated and needs no maintenance.

The steering system is mounted in well-proportioned rubber bushings which, together with the front-wheel suspension, effectively absorb the shocks from irregularities in the road surface at all speeds. The system also provides the driver with excellent information on what is happening between the tires and the road surface.

The steering servo acts by hydraulic pressure directly on the rack and is of "progressive type", i.e. it provides increasing assistance towards each lock, which is particularly useful when parking the car in confined spaces.



The lightweight, beam-type rear axle causes a minimum of undesirable steering effects and provides superb roadholding. Carefully complemented springing and a low-level Panhard rod result in well balanced comfort.



Transversely mounted engine and gearbox located forward of the front-wheel center.

MacPherson strut with direct-acting gas shock absorber with extra sturdy design. Stiff stabilizer bar for the front suspension and sturdy lower wishbone secured to the subframe.

Lower forward arm, upper rearward arm, conical coil spring, direct-acting gas shock absorber, low-level Panhard rod and stabilizer bar for rear suspension.

Rear axle

The rear axle is straight and rigid, and is very firmly and accurately located laterally. This feature, combined with the short overhangs of the car, is one of the most important reasons for the fast and distinct response of the Saab 9000. The roll center is very low, which prevents body roll.

The rear axle consists of a lightweight but rigid tube, secured to the body by two leading and two trailing arms. In addition, it is equipped with a Panhard rod and stabilizer bar. In a car with rear-wheel drive, the design of the rear axle would have to be appreciably more complicated to eliminate the undesirable side effects of this type of design.

The Panhard rod of the Saab 9000 is fitted at a low level and is secured to the body at a low point, to eliminate the undesirable and fatiguing lateral swaying movements of the body. In the same manner as the stabilizer bar, the Panhard rod is mounted in well-matched rubber bushings.

The rear axle suspension consists of conical coil springs of "hemispherical" form at the top, thereby contributing to the large luggage compartment capacity. The gas shock absorbers are direct-acting and are secured directly to the axle.

The arms are long and are mounted in relatively soft rubber bushings. Due to their length, soft springs with a long travel (8.27 in./210 mm) can be used. The design contributes to extremely good roadholding and high comfort.

"The suspension is surprisingly comfortable, considering the very modest rolling tendency on hard cornering..."

TEKNIKENS VÄRLD
Sweden

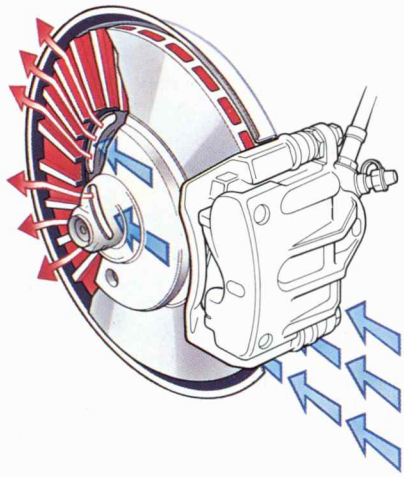
The Saab Anti-lock Braking System enables you to follow your natural instinct to brake hard during a panic stop situation, while maintaining steering control of your car.

Saab Anti-lock Braking System

The Saab 9000 includes an anti-lock braking system (ABS) as standard equipment. ABS offers greater safety under virtually any motoring conditions and on almost all road surfaces. It prevents the wheels from locking and the maneuverability of the car thus remains unimpaired, so that the driver can apply the brakes hard and at the same time swerve past the obstacle.

The stable, functional chassis of the Saab 9000 is designed with ample margins to withstand the pulsating forces applied by ABS. The Saab anti-lock braking system provides excellent pedal feel, so that the driver can sense how the brake system is behaving. But you are kept aware at all times of what is happening between the tires and the road surface. Moreover, the Saab system is quieter than other types of anti-lock braking systems.

The Saab anti-lock braking system gives you double safety. Two entirely independent electronic circuits monitor the conditions and compare signals. One sensor at each wheel records the speed of the wheel and transmits the information to a microprocessor which compares the signal with those from the other wheels. If one of the



The Saab 9000 has disc brakes all around, ventilated in front.

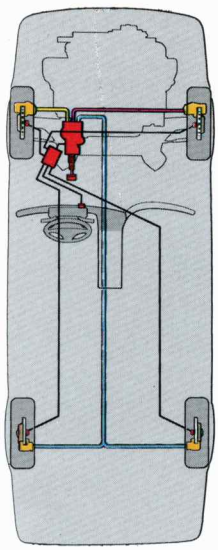
The Saab anti-lock braking system regulates the braking effect so that all wheels can be braked at maximum pressure without locking. This enables the driver to retain control and steer around an obstacle.

wheels is about to lock or if its speed should drop in relation to the others, the electronics will immediately lower the brake pressure on that particular wheel. All this pressure control happens no less than twelve times a second.

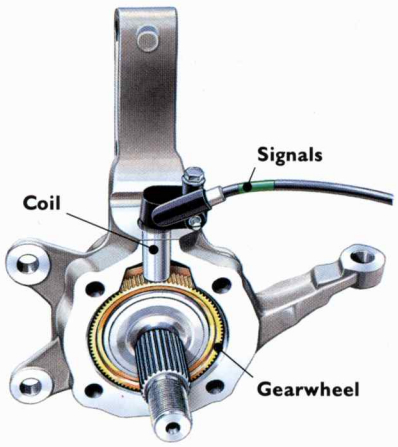
The brake system is self-testing. The two independent electronic circuits will run a test on the brake system automatically every time the car is started, to check the brake pressure, brake fluid level and the performance of the wheel sensors. If the brake system performs satisfactorily, a warning lamp in the instrument panel will be switched off five to ten seconds after the engine has started. The safety functions are also checked continuously while the car is travelling.

The Saab anti-lock braking system is fully integrated, and all its main components are incorporated into one compact, lightweight unit. A further benefit is that the entire system is pre-assembled and inspected before it is installed in the car, which contributes to reliability.

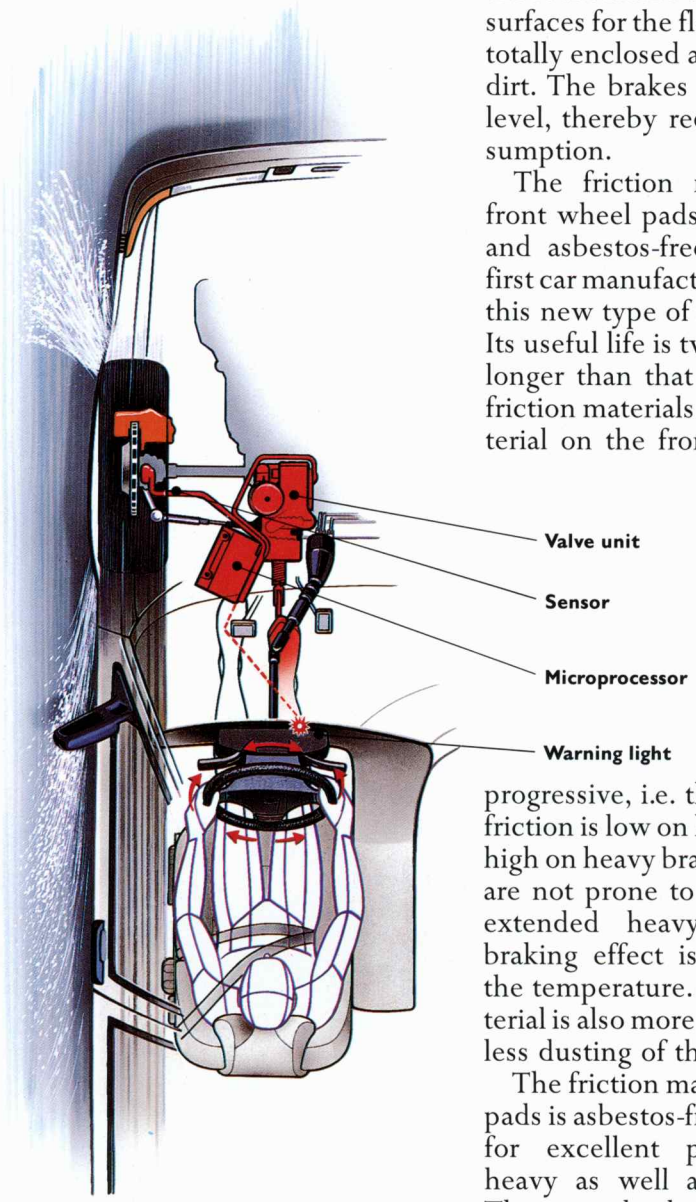
The Saab 9000 has an advanced brake system with large diameter disc brakes all around. The front discs are ventilated. All Saab 9000s have extra large brake calipers, linings and thicker discs for better braking performance.



The anti-lock brake system has three circuits, one to the rear wheels and one to each front wheel.



A built-in, moisture-proof sensor at each wheel records the rolling speed of the wheel. The sensor is inductive—an electric current is induced in a coil every time one tooth of a gearwheel passes the sensor.



The Saab anti-lock brake system prevents the wheels from locking so the driver can apply the brakes hard and at the same time swerve past the obstacle.

The location of the brake pedal corresponds accurately to the driver's seating attitude. The brakes are power-assisted, with a well-balanced braking effort, even when braking hard from very high speeds.

The Saab anti-lock braking system has three brake circuits—one for the rear wheels and one for each of the front wheels. This ensures that over 50% of the braking ability will remain if one circuit should fail.

Due to the floating brake caliper, the brake fluid is subjected to less heat than in conventional brake calipers. This eliminates the risk of the brake fluid boiling. The sliding surfaces for the floating caliper are totally enclosed and insensitive to dirt. The brakes have a low drag level, thereby reducing fuel consumption.

The friction material on the front wheel pads is semi-metallic and asbestos-free. Saab was the first car manufacturer to introduce this new type of friction material. Its useful life is two to three times longer than that of conventional friction materials. The friction material on the front-wheel pads is progressive, i.e. the coefficient of friction is low on light braking and high on heavy braking. The brakes are not prone to fading, even on extended heavy braking. The braking effect is high, whatever the temperature. The friction material is also more silent and causes less dusting of the wheels.

The friction material on the rear pads is asbestos-free. It is designed for excellent performance on heavy as well as light braking. The rear-wheel pads have an opposite characteristic to that of the front-wheel pads, i.e. the friction is high on light braking and low on hard braking.

Emphasis on total performance belies Saab's huge commitment to safety. By definition, total performance stimulates safety through a combination of active and passive systems. By design, a performance car can easily offer a higher level of safety than that of a lesser vehicle if such safety elements are combined intelligently.

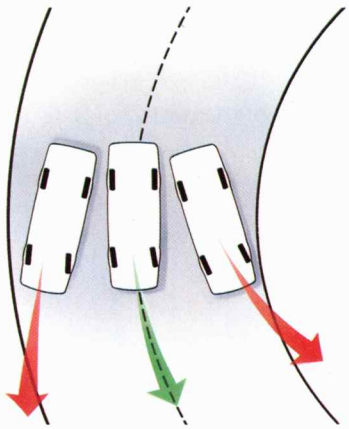
Visceral Feedback for Driving Precision

Designing and developing cars the Saab way has placed demands on this airplane maker turned car manufacturer. Historically Saab has not only strived to provide both driver and passenger with everything they perceived necessary in a vehicle, but has also attempted to supply everything they wanted as well. Saab has never sacrificed performance at the expense of safety, or utility at the expense of comfort, and for the past forty years, has done so with a consistent emphasis on value.

Saab performance is not limited to 0–60 mph acceleration time or top speed; Saab safety is not defined by merely satisfying standards mandated by government agencies; nor is Saab comfort considered an attempt to duplicate the plushness of a household livingroom. Saab's total performance approach provides a driving experience that is unparalleled.

For the engineers at Saab, the development of what constitutes the driving experience is considered a scientific discipline—just like mathematics or physics. It is a science that is based on the philosophy that one should drive by the fingertips, the ears and the seat of one's pants. The chassis specification must be designed to communicate to the driver quickly and accurately, and enable him or her to respond immediately to changes in vehicle attitude and varying road conditions. Front-wheel drive, rack and pinion steering, a communicative suspension

The Saab 9000 has good directional stability under a variety of conditions, even in strong crosswinds.



When a car with understeer enters a curve at high speed, the front of the car tends to drift outwards. If the car has oversteer, the rear will instead tend to drift outwards. The steering of the Saab 9000 is neutral, so that all four tires exert maximum grip.

The track is wide, and the car has very little tendency to roll when subjected to lateral forces. The front suspension spring travel is long for firm contact with the road, even when the car is cornering hard.

Front-wheel drive, rack and pinion steering, a communicate suspension system and favorable weight distribution transmit vital information to the driver through the steering wheel and the driver's seat.

Saab's total performance approach provides a driving experience that is unparalleled.

system and favorable weight distribution transmit this vital information to the driver through the steering wheel and the driver's seat.

Saab's visceral approach to the driving experience also extends into the science of sound. It is not only a question of providing "feel" without discomfort, but also allowing "sound," not noise. Saab believes that the car should not be a cocoon isolating the driver from the world outside. So instead of the sounds from the road and engine being suppressed to the point of elimination, leaving the driver isolated, they have been cleverly attenuated. The sounds heard by a Saab driver aren't intrusive; they're informative, keeping the operator in touch with the road and in constant communication with the vehicle.

Saab's unique approach to total performance, and the driving experience as a whole, provides a unity between man and machine. A responsive vehicle with an appropriate assortment of active and passive safety features contributes to a heightened sense of driver control and provides a driving experience that is safe, comfortable and enjoyable.

The basic chassis principle of the Saab 9000 is that the contact between the road and the car be naturally extended into contact between the driver and the car.

Chassis philosophy

Good directional stability and fast, correct response of the car are important ingredients of a soundly designed chassis. The contact between the road and the car must naturally be the basis of good "communication" between the driver and the car. This is the fundamental principle of the chassis design on the Saab 9000.

The 9000 has good directional stability under a variety of conditions, even in strong cross-winds, and behaves consistently on all types of roads and surfaces. The car acts predictably with a full load or with the driver alone—even if it is accelerated, decelerated or braked in a curve. The 9000 responds very quickly and distinctly to the steering wheel and behaves safely in sudden swerving maneuvers.

As mentioned earlier, the Saab 9000 has been designed with the focus on people. This applies no less to the driver's environment than the chassis. The driver constantly receives clear and reliable information through the steering wheel, the pedals and the seat. This is an important attribute that affects the driver's actions and assists him or her in critical situations. In addition, the 9000 is a "forgiving" car by providing the driver with margins for mistakes, instead of amplifying them.

Lateral acceleration

The interaction between the driver and the car can be illustrated by what happens when the driver turns the steering wheel. The response of the car can then be described in terms of yaw and lateral acceleration. The yaw rate is a measure of how quickly the car changes course. This is recorded by the driver's eyes. The lateral acceleration is a measure of the forces acting transversely on the car. The driver detects this by the side pressure applied by the seat to the driver's back. The seat, in turn, receives its information from the tires, through the chassis and the body.

If the car should skid, the yaw rate will increase and the driver will detect this with his or her eyes. At the same time, lateral pressure on the driver's seat will decrease since the tires will have lost their grip and will transmit no forces. This will be detected by the driver's body.

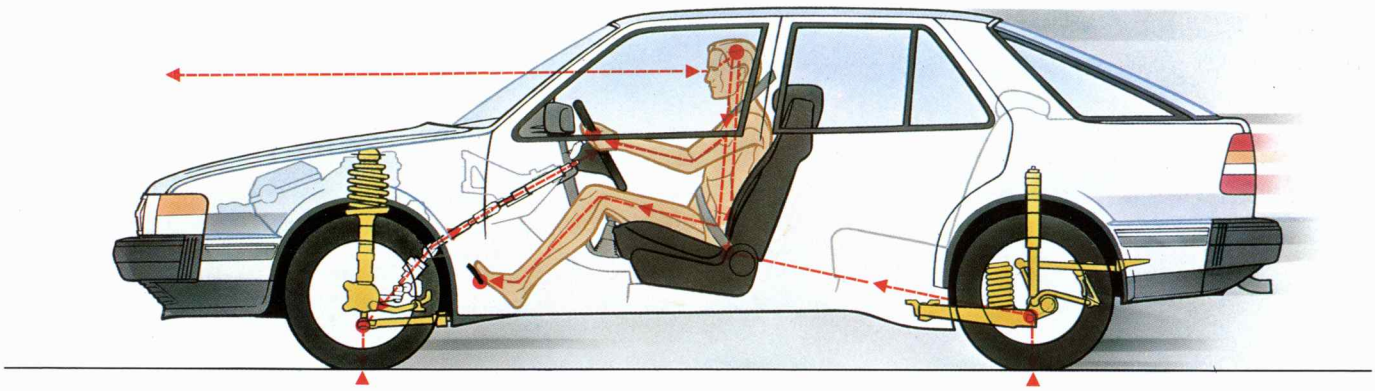
A fully able-bodied person is extremely receptive to changes in both of these phenomena. The driver will react to even very small variations and will make the necessary corrections with the steering wheel. So it is vitally important for this information to be clear and correct.

The Saab 9000 chassis provides maximum comfort combined with superb roadholding.

Optimized chassis geometry

In the Saab 9000, all such characteristics are carefully matched in the various design features of the car, to provide the driver with correct information. The combination of optimum chassis geometry and exact interplay between the driver and the car has resulted in its good roadholding and good road behavior characteristics.

Owing to one of these unique design features, the Saab 9000 approaches the break-away limit very slowly, i.e. the driver is given ample warning when the tires begin to lose their grip. Purely tech-



The driver interprets the movements of the car via fast, accurate signals from chassis, driver's seat, vision, etc.

nically, this has been achieved by the rear axle being designed to provide a certain amount of side force oversteer. This means that, on cornering, the rear axle "gives" slightly, resulting in a small slip angle between the tires and the road (i.e. the angle representing the difference between how the tires tend to run and how the remainder of the car forces them to run at a slightly different angle).

Break-away limit

What is known as the grip is actually a result of the small contact area between the four tires and the road surface. So it is important to maintain this contact as long and as firmly as possible. Due to a fully able-bodied person's ability to detect slight changes, the driver of a car with side force oversteer will feel that the car is starting to drift when it is cornering fast and will thus be forewarned that the car is approaching the break-away limit.

On the other hand, a rear axle with side force understeer, i.e. with a larger drift angle between the tires and the road surface, will not forewarn the driver, and the tires will lose their grip suddenly on a slippery surface. Side force understeer is particularly common on cars with a large overhang at the rear and is designed to counteract the poor response of the car—substantially impairing the interplay between the driver and the car.

Neutral steering

The beneficial side force oversteer of the Saab 9000 has been achieved by locating the Panhard rod forward of the rear axle, instead of the usual location behind the axle. In addition, the required steering effect is provided by the slightly plough-shaped arrangement of the spring links and the elasticity of the Panhard rod bushings. The wheels are well-guided by the arm arrangement which acts as a system of infinitely long stays. The shock absorbers act directly at the center of the rear axle and therefore exert no undesirable steering effect.

Due to its advanced chassis design, the Saab 9000 has very safe properties at the break-away limit, and it has therefore been possible to make it neutral in its behavior. Its steering is neutral, so that all four tires exert maximum grip, with very small slip angles. In practice, this means that under controlled conditions, the Saab 9000 can be driven faster in a curve than cars with different chassis designs, before the critical break-away limit is reached. The Saab 9000 approaches this limit slowly and distinctly.

> **"... soaked up medium-to-long pitch undulations beautifully, without any float. A secure but comfortable ride. Where possible, we tried to use the full cornering power. What transpired was wonderfully gentle and progressive handling... It is the sort of car that inspires confidence."**
>
> AUTOCAR
> Great Britain

Ride comfort

The chassis is designed to provide maximum riding and driving comfort at all speeds. From the comfort standpoint, the function of the chassis is to attenuate vibrations of different frequencies and eliminate fatigue for the occupants. Neither of these disturbances is usually apparent on a short trip or a test drive. But after a longer journey in a car with these shortcomings, the passengers and driver will feel tired, stiff and uncomfortable. Much work on the Saab 9000 has therefore been devoted to combining good roadholding characteristics with high driving and riding comfort.

In technical terms, this has been achieved by features such as the light, beam type rear axle, soft springs, suitable shock absorbers, well-proportioned rubber bushings, low-level Panhard rod that gives a low roll center, and the stabilizer bars which effectively counteract the rolling tendencies of the body. When only one wheel rides over a bump, for instance, the mounting points in the body will only move a short distance, which reduces the undesirable side movements of the body and the fatiguing "swaying" motion, i.e. the very tiring and unfortunately very common lateral movement that causes the occupants' heads to sway from side to side. The beam type rear axle also eliminates the undesirable steering effects and the soft bushings damp out the vibrations.

Roadholding

Front-wheel drive with 60% of the weight supported by the driven wheels:
- Excellent grip and cornering characteristics, even on a slippery surface.
- Excellent roadholding.
- High road safety.

15" wheels with high-speed tires:
- Ample space for large brake discs.
- Good mobility under varying road conditions.
- High ground clearance.
- Little risk of sudden break-away in critical situations.

Power-assisted rack and pinion steering:
- High precision, fast response.
- Good feel of the road.
- Effective damping of the irregularities in the road surface.

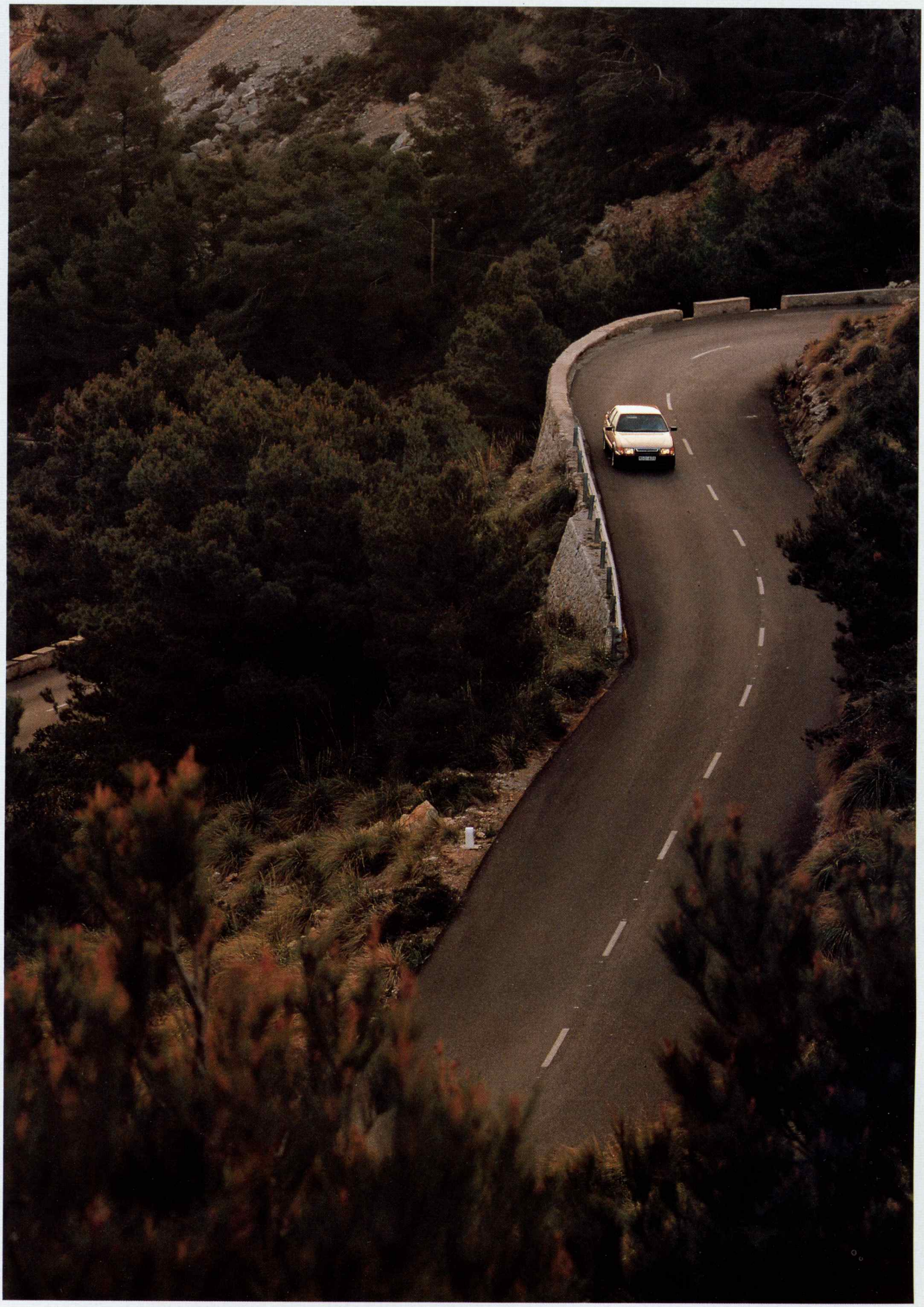
Integral tapered wheel bearings:
- Maintenance-free.
- Long useful life.

Front suspension by McPherson struts secured to the steering knuckle housing:
- Simple, robust design.
- Long spring travel—excellent roadholding.

Lightweight, beam-type rear axle, direct-acting gas shock absorbers, low-level Panhard rod and stabilizer bar:
- High directional stability.
- Low rolling tendency.
- No undesirable steering effects.
- Effective vibration attenuation.
- No service required.
- No tiring body sway.
- High standard of comfort.

Three-circuit anti-lock braking system with large discs all around, floating calipers and optimized, asbestos-free brake pads:
- The driver can exert maximum braking power and retain steering control.
- Major active safety improvement on slippery road surfaces.
- Self-monitoring system with double electronic units.
- Fast-acting adjustment system with excellent pedal feel.
- Safe braking characteristics, even if one circuit should be damaged.
- Long useful life.

Chassis principles:
- "Forgiving" chassis characteristics.
- Optimized chassis geometry and accurate interplay between the driver and the car.
- Side force oversteer.
- Small slip angle between the tires and the road surface.
- Neutral steering characteristics.
- Low roll center.



COMFORT

“The interior dimensions are almost gigantic… The whole of the interior exudes first-class comfort. The various details are well planned and often ingenious, without being obtrusive… the car has been designed by people who really know what motoring is all about…”

VI BILÄGARE
Sweden

The driver's cockpit is the focal point of the Saab 9000. This is where all the incoming information must be processed, and where all the commands are given to the car. So the entire car has been built up from the driving position outwards.

Driver environment

The location and arrangement of the equipment in the Saab 9000 is always based on the human being's needs and capabilities. Saab was determined not to overload the driver with excessive information. This has resulted in a convenient, clearly arranged "workplace" for the driver.

Efficient cockpit

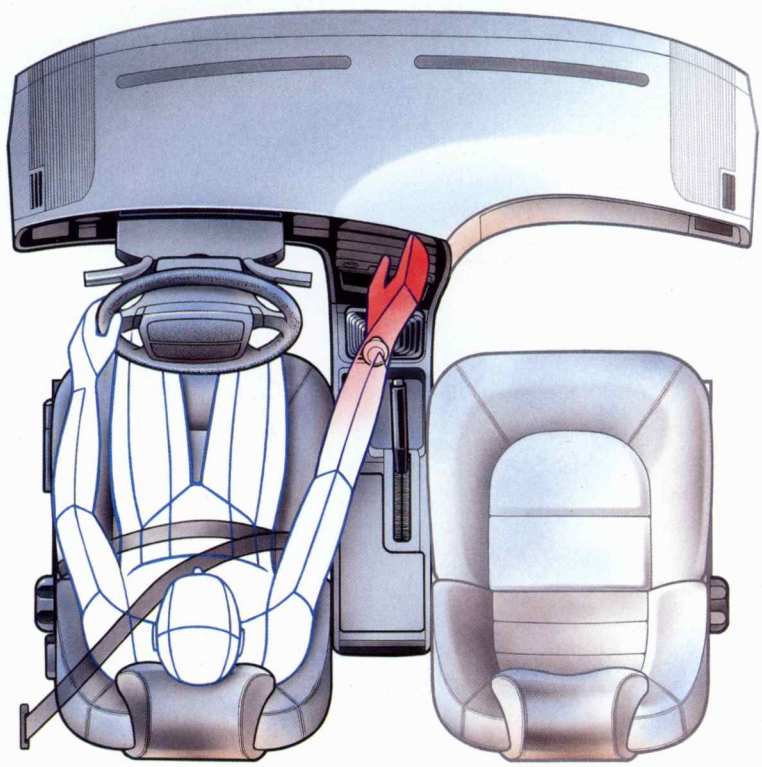
The driver's environment must perform equally well for all drivers—this was an important factor in the design work. People of different statures must have the same opportunity to drive the 9000 safely and efficiently. Computerized calculation work, supported by the results obtained from large test groups comprising people of varying statures, have formed the basis for the design of the driver's station. The flexibility of the cockpit is one result of this work. The driver's seat, for example, has a wide range of adjustments.

Sight and visibility play an important role in the driver's work. The instruments and warning lamps have therefore been arranged in an entirely non-reflecting location, high up within the driver's natural field of vision. So re-focusing from the road ahead to the instruments takes a minimum amount of time.

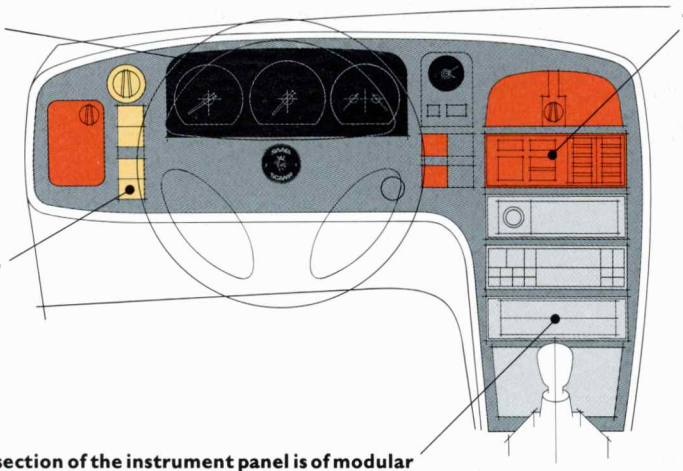
All instruments in the Saab 9000 are circular and of analog type. The aeronautical engineering experience of the Saab-Scania Group has clearly proved that such instruments are most effective for conveying information quickly and unambiguously. The peripheral vision of a person will detect changes in position of a large instrument needle appreciably more easily than it will the changes in the figures on a digital instrument or changes in the bar of a bar-type instrument. So the instruments have clear, white symbols and large yellow/orange pointers, illuminated from the inside and set against a matte black background.

Controls

All components mounted on the instrument panel are located in logical zones and are marked with clear symbols. Since the various controls are arranged in groups, it is always easy for the driver to find the right control and avoid mistakes in critical situations. The instrument panel is of asymmetrical design and follows the natural reach curve of the driver. The complete instrument panel is pre-as-



The instrument panel is of asymmetrical design, to follow the driver's natural reach pattern.


The instrument and control zone is relatively high, so the driver need hardly lower his or her eyes from the road.
The comfort and vision zone contains the controls for interior heating and ventilation, front-seat heating, and the stalk for the windshield wipers.
This zone contains the controls for the various lighting functions, including the steering column stalk.
The central section of the instrument panel is of modular design. Any unused compartment can be used for storage.

The driver's environment is easy to work in, and everything is clearly marked. All instruments and controls are located in logical zones to avoid possible errors in critical situations.

sembled, which ensures high reliability, a good fit and high quality.

Switches and controls of three main types are used:
Push buttons, control knobs and steering column stalks. As always on the Saab 9000, the type is determined by the human being's natural pattern of movement and his capabilities. Push buttons are used for on/off operation of various functions, control knobs whenever several functions can be selected and steering column stalks in the traditional manner for high beams, direction indicators, wipers and washers. All stalks are mounted on the steering column, are clearly visible through the steering wheel and are within fingertip reach for quick operation.

The push buttons on the instrument panel have symbols that are illuminated from the inside to indicate their function.

Visibility

The visibility around the car is obviously also very important. So the Saab 9000 has large windows, with slender roof pillars arranged to restrict visibility as little as possible. Both exterior rear-view mirrors are operated electrically from inside the car. The passenger side mirror is a wide-angle type, and both rear-view mirrors are also electrically heated. The windshield wipers have very large blades which sweep over a large proportion of the windshield surface.

All instruments are circular analog units with large pointers. Aviation-industry tests have proved that instruments like these are the most effective for conveying information quickly and unambiguously. The instruments are illuminated by green light which is suitably restful for night driving.

Instruments

To eliminate glare and reflections, the instruments are deeply recessed in the instrument panel.

Instruments and controls are lit indirectly with green light for the best night visibility. The use of green illumination also avoids any possible confusion with the panel warning lamps.

Warning lamps

The various warning symbols on the lower area of the instrument panel can be seen only when they light up and when the ignition is switched on for pre-journey checks. This avoids distraction and false alarms, and ensures that legitimate warnings attract instant attention.

A pictogram (lower left of the panel) shows an outline of the vehicle viewed from above. The lamps at the corners indicate failure of the front or rear car lamps. The pictogram also shows any open or improperly closed doors, as well as low oil pressure.

The remaining warning lamps are located at the lower right of the

In the Saab 9000 cockpit all controls and instruments are placed exactly where the driver expects to find them.

Tachometer specially marked for economical driving. The instruments have clear white symbols and large yellow-orange pointers against a matte-black background. All instruments are recessed and reflex-free.

Speedometer, odometer and tripmeter. Instruments illuminated by indirect green light

Engine temperature, turbo boost pressure and fuel gauges

Pictogram that indicates failure of external lights or improperly shut doors. If a fault should occur while the car is travelling, the appropriate symbol will light up in the pictogram.

Electronic display for the EDU instrument

Warning and indicator lamps. The symbols are visible only when lamps are activated and for checking purposes when starting.

panel. The symbols of the direction indicator lamps are as high as possible above the analog instruments.

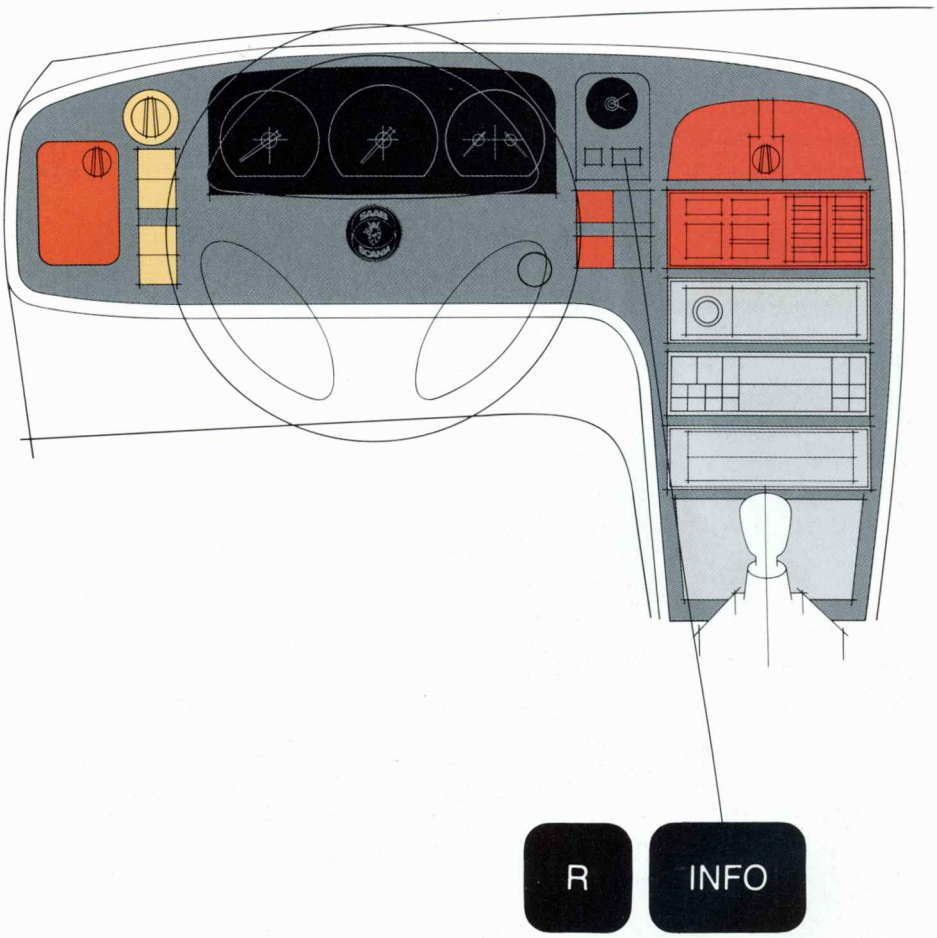
Electronic Display Unit

The Electronic Display Unit (EDU) instrument is located immediately below the speedometer. The EDU instrument can be programmed to show average or instantaneous fuel consumption or the voltage of the electrical system. The EDU instrument can also show the fuel remaining in the tank, the ambient temperature and results of checks on the engine, coolant level and engine oil level.

The desired EDU functions are selected using the pushbuttons on the clock unit.

"The round instruments are easy to read. The controls are well arranged and the clear markings make them immediately easy to use. The front seats can be adjusted in different ways, even in height..."

AUTOMOBIL REVUE
Switzerland



Command buttons for the EDU instrument.

There is no doubt that the Saab 9000 driver's seat is one of the best in the passenger-car world. It is anatomically designed to be comfortable mile after mile, and to give the driver optimum "feel" of the car.

Driver's seat

In addition to being comfortable, the driver's seat of the Saab 9000 also supplies the driver with a large proportion of the information on how the car is behaving. We have designed the seat so that it will convey as much information as possible, while still being ergonomically correct and comfortable on long journeys. Its design is based on the "active comfort" concept.

The seat is of sound anatomical design and has a sufficiently wide range of settings to ensure that it will be practical and comfortable for virtually any driver. To achieve this objective, the designers have based all of their work on the Seating Reference Point (SRP), i.e. the hip point. In the Saab 9000, the SRP is very low, which helps to integrate the driver with the car. This also contributes to the abundant interior space.

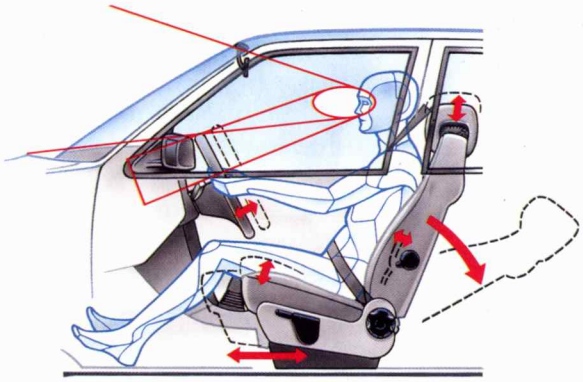
The seat of the Saab 9000 consists of a few large, integrated parts. The front seats can be adjusted fore and aft, the backrest rake can be reset and the head restraints can be raised and lowered. The top anchor point of the seat belt is adjustable in height, and the two bottom anchor points are secured directly to the seat frame to maintain optimum occupant fit regardless of seat position. The seat cushion and the backrest of the driver's seat can be adjusted vertically and lumbar support is also adjustable. Additionally, both front seats are electrically heated, with four-position control switches on the instrument panel.

Power seats

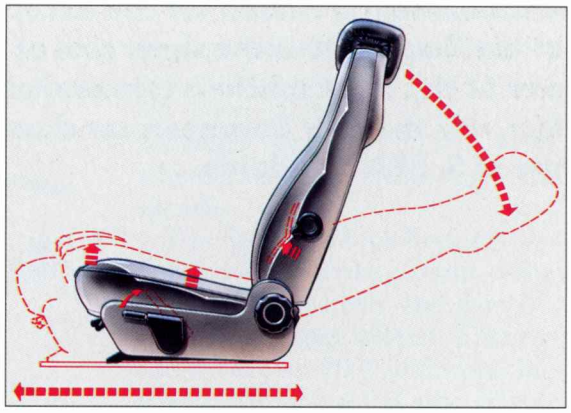
In cars equipped with power seats, two control buttons located on the outboard seat bottom allow convenient adjustment of fore-aft seat travel, seat bottom height (front, rear or both) and seat back angle.

High side ridges support the body firmly. The leather or cloth upholstery is comfortable and durable.

In cars fitted with electrically-adjustable front seats, the ideal seating position can be found at the touch of a button. A memory function is included that allows programming for three different settings, which is very convenient if the car is regularly used by different drivers and passengers.



The driver's environment is designed to suit drivers of different stature equally well.



A driver's seat with so many adjustments makes it easy to find the most comfortable driving position.

The seat and backrest are padded with polyurethane foam, with built-in Pullmaflex netting and coil springs at the edges. The form provides effective and restful support for the thighs and back.

The head restraint is built up on a backing plate of special design, covered on the outside with soft padding. The backing plate helps prevent injuries on impact from the front or rear.

The leather or fabric upholstery is wear-resistant, colorfast and dimensionally stable. The fabrics are subjected to flame-retardant treatment.

The temperature of each front seat's heating pads is manually adjustable by means of controls on the instrument panel.

The seat can be adjusted fore-and-aft by 8.3 inches along slide rails recessed in the floor.*

The lumbar support is adjustable to three alternative settings, which modify the backrest contour.

The back rake is smoothly continuously adjustable.*

The height of the seat cushion can be adjusted by about 2 inches by means of a telescopic lever on the side of the seat.*

The height of the thigh support can be adjusted independently.*

* Manual controls on standard driver's seat.

A fundamental reason for the exceptional comfort of the Saab 9000 is the sheer size of its interior. This is one of the most spacious cars available anywhere. In fact, it is the only European car classified as "Large" by the U.S. EPA standards.

Interior space

Driving and riding comfort are both outstanding in the Saab 9000. The seating has reached a highly advanced stage of development. In combination with Saab's unique interior design and styling, it provides an efficient, non-tiring command post for the driver and a luxurious, strain-free environment for the passengers. The Saab 9000 can carry people long distances at varying speeds, and deliver them relaxed and refreshed.

The materials and finish of the interior are of very high standard. The carpet is soft, dense and durable, and matches the upholstery as well as the rest of the interior.

One of the fundamental prerequisites for maximum comfort—which benefits the driver as well as the passenger—is a lot of interior room. The Saab 9000 is classified as a "Large Car" by the EPA. This classification accurately reflects the car's unusually large inside dimensions.

"... accomodation totally out of proportion to its external dimensions... a vast amount of space... when a six-footer stretches out in the front another six-footer can do the same in the rear..."

CAR
Great Britain

Back seat

The back seat offers an extremely high standard of seating comfort. In addition to its ample headroom and impressive width, the fore-and-aft space is also very generous. So back seat passengers have an exceptional amount of legroom.

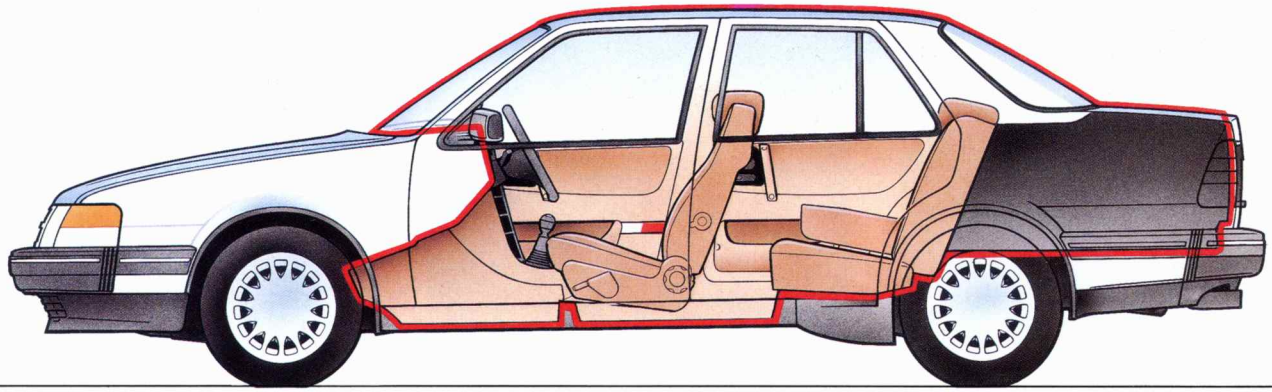
Due to the contoured design, the back seat is as comfortable as the front seats. The padding is of the same quality as that used in fine furniture, with a spring-interior seat cushion instead of the usual foam material. Since this cushion is dimensionally stable, back seat passengers can travel in maximum comfort, even on long journeys. The seat cushion is of the same thickness throughout the width of the car, and even the center passenger will be comfortable. When only two persons are seated in the back, the center armrest can be folded down for even greater comfort.

Back seat passengers are provided with head restraints and three-point seat belts for the two outboard seating positions, and a lap belt for the rear center position.

Comfort features

Time and again "little details" make a big difference in determining how well a particular car suits you. They may seem unimportant and yet contribute in a major way to the comfort and pleasure of everyday driving. Here are a few examples. Courtesy lights illuminate the ground below the door when people are getting in or out of the car. At the same time, a red light shows to the rear, to warn other road users.

The individual reading lamps for rear-seat passengers have well-defined light cones to allow their use without disturbing the driver.



The advantages of its spacious interior are supplemented by the way the car performs on the road, e.g. when cornering, in crosswinds, and on rough surfaces. The Saab 9000 CD was designed for drivers seeking luxury car comfort matched by performance car capabilities.

Despite its compact exterior, the Saab 9000 has a large, airy interior. It is one of the largest sedans on the market. There is generous headroom, legroom and shoulderroom in both front and rear.

The Climate Control System in the Saab 9000 is one of the most advanced on the market. As standard features it incorporates both an air conditioning and a high-capacity heating and ventilation system, as well as micro-processor-controlled automation. You only have to select a temperature and the system will adjust the interior temperature automatically.

Climate control system

Saab has always fitted its cars with high-capacity heating and ventilation systems, to allow for the rigors of the widely-varying Nordic climate. The heating, ventilation and air conditioning system is capable of meeting comfort demands in all climates.

The system also includes a ventilation air filter, to prevent most dusts and pollens from entering the interior of the car. The entire system including the microprocessor-based Automatic Climate Control (ACC) system, has been designed by Saab specifically for the 9000.

Heating / Ventilation

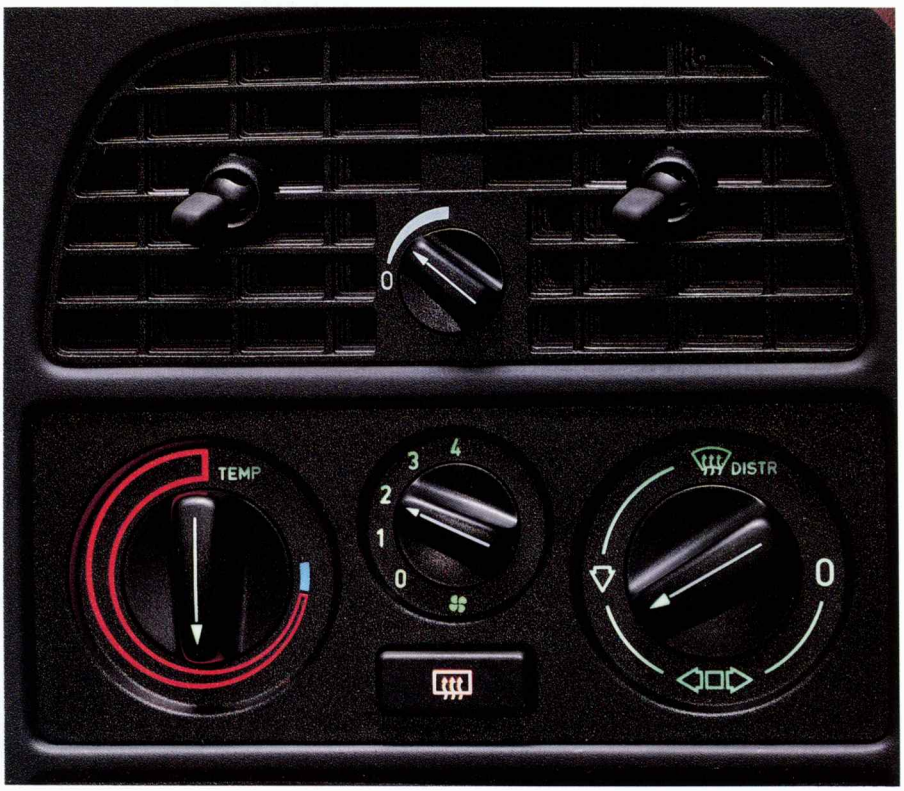
The heating and ventilation system has high capacity and is integrated into one unit, comprising the fan, heat exchanger and damper housing. The location of the system between the interior and the engine compartment provides effective sound insulation. The heating and ventilation system is pre-assembled before being fitted into the car. The Saab 9000 is fitted with tinted windows as standard.

Electric heating of the rear window is switched off automatically ten minutes after it has been switched on, in order to limit electrical current consumption. When electric heating of the rear window is switched on, the external rear-view mirrors will also be heated. On models equipped with ACC, a fan system is also fitted within the rear doors for improved side window demisting.

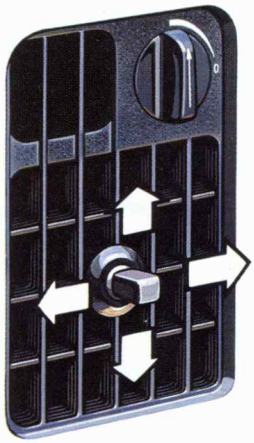
Air Conditioning

The air conditioning system has a high-capacity compressor, located well away from the interior. It is therefore easily accessible and the sound it emits is not transmitted to the interior. Most components are accessible from the engine compartment, which facilitates service work.

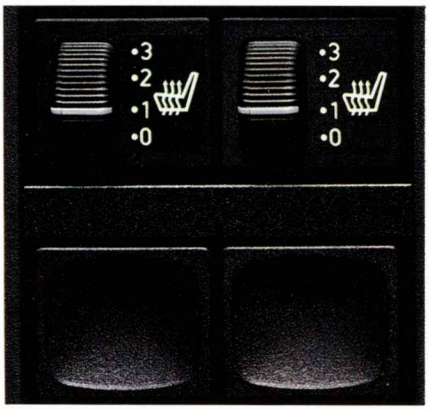
All cars are also fitted with a ventilation air filter. The Saab 9000 is the first car in which an air conditioning system is integrated with an efficient ventilation air filter. Some 9000 models have manual, rotary controls for fan speed, temperature and air distribution, plus push buttons for air conditioning and rear window demister selection, while other models are equipped with Automatic Climate Control.



Logical design of heating and ventilation controls permits simple adjustment of airflow temperature, direction and distribution.

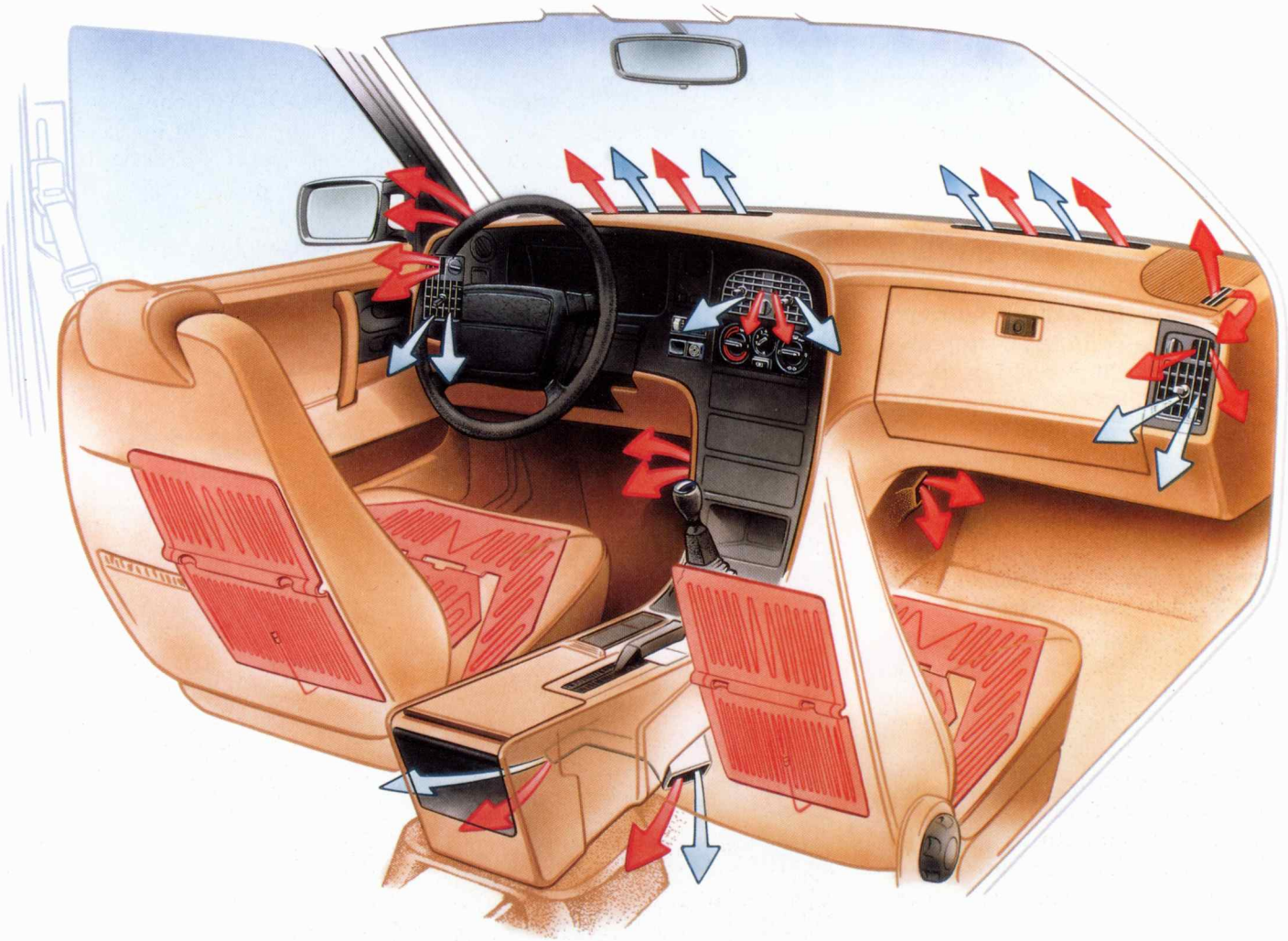


The front of the instrument panel is fitted with a number of ventilation air outlets. Separate controls are provided for regulating the airflow rate and direction.

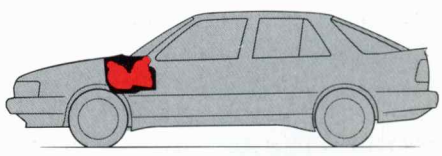


The front seats are equipped with heating pads in the seat and backrest. The heating of each seat is adjustable individually.

The exterior rear-view mirrors are electrically heated to avoid misting.



The clean air—warm, cool or at ambient temperature—can be distributed in the interior through a total of 13 outlets. This provides effective but draft-free defrosting, heating, cooling and ventilation to suit all conceivable requirements. Four defroster outlets are also provided for the side windows. This new heating system stratifies the airflow—the air supplied into the footwells is warmer than that admitted at face level. Individually adjustable, thermostatically controlled heating is also provided for both front seats.



Part of the heating system is located in the interior and the remainder in the engine compartment, between the two bulkheads. This is where the fan is located to reduce noise.

ACC—Automatic Climate Control

The Automatic Climate Control (ACC) microprocessor-based system monitors and controls the in-car climate and the air conditioner. The required temperature can be preset on the ACC, and high-precision temperature transmitters will then supply the necessary data to the microprocessor, to control the temperature, air distribution, fan speed, recirculation, separate defroster fans for rear door windows, and electric heating of the rear window. Provision is also made for manual overriding of some or all of the ACC functions, or for shutting the system off.

A sensor for the interior temperature is fitted to the left of the ACC panel and a sun sensor is mounted on top of the dashboard in the center. Two other sensors are located in the inlet air plenum.

All functions that have been selected manually can be reset by depressing the "AUTO" button or by pressing again the button used for selecting the function. To ensure durability, push-buttons with markings are subjected to the same surface treatment as that used for typewriter keys.

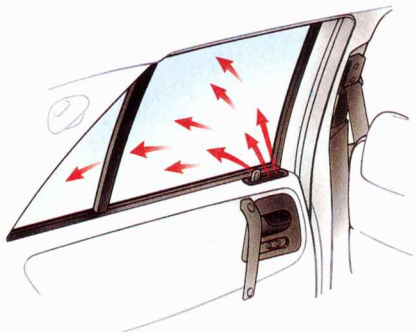
If the accelerator pedal is pressed down hard, the air conditioning compressor will be temporarily taken out of operation, to improve the overtaking performance of the car. The air conditioner has a very high compressor capacity, to ensure efficient cooling.

"... the automatic air conditioning system installed by Saab merits special mention. It includes a sophisticated air filter that arrests dirt particles and even pollen. So allergy sufferers will find a safe haven in the interior of the CD, particularly during the spring months."

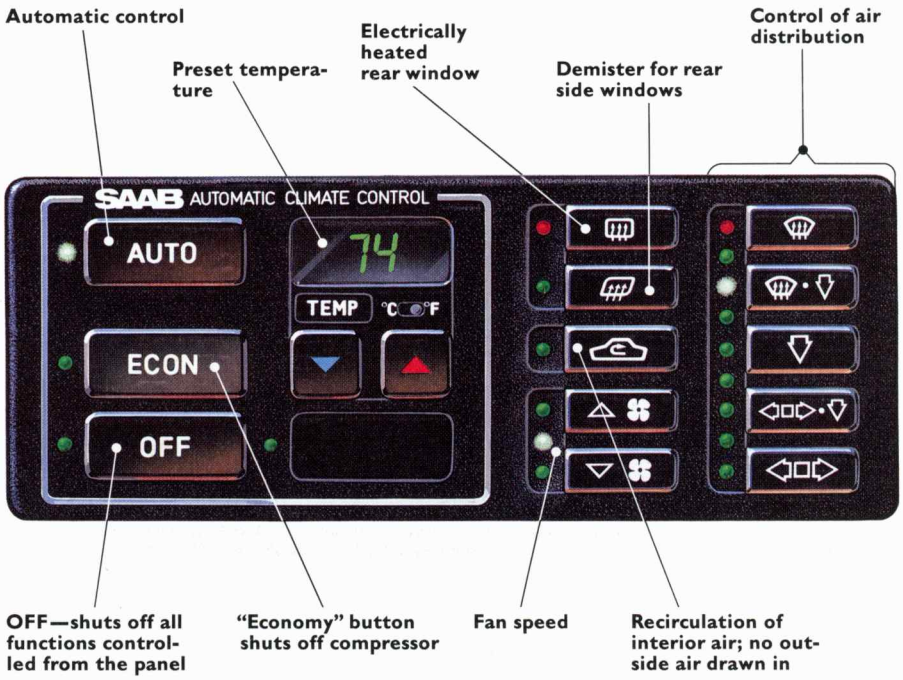
AUTO SPRINT
Italy

The ACC system can be left permanently preset, regardless of the weather. The ACC will then start the appropriate units and adjust them automatically. The various dampers of the system are controlled by electric motors.

The solar sensor, mounted on top of the dashboard, senses the direction and intensity of the sun's radiation.



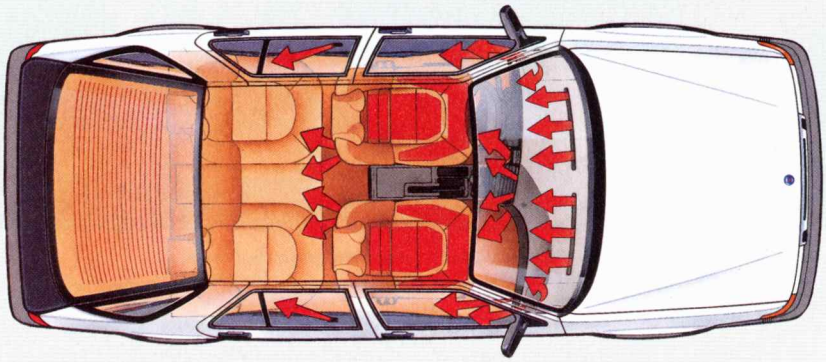
Separate defroster fans keep rear windows clear efficiently.

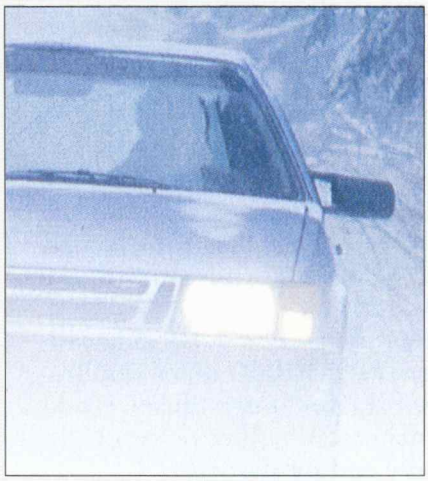


The control panel features clear, logical symbols. Normally the climate control system is completely automatic, but it can alternatively be controlled partially or totally manually.

Operation of the ACC system :

ACC automatically regulates the climate in the car regardless of outside temperature and weather conditions. All you need to do is set the temperature desired. In these two examples, a temperature of 74°F (23°C) and fully-automatic control have been selected on the ACC panel.



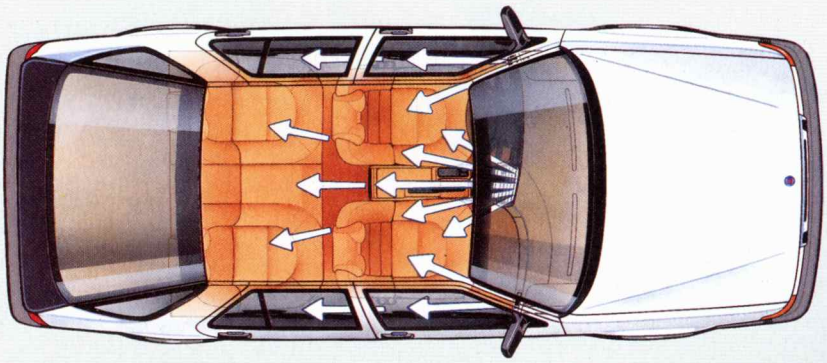


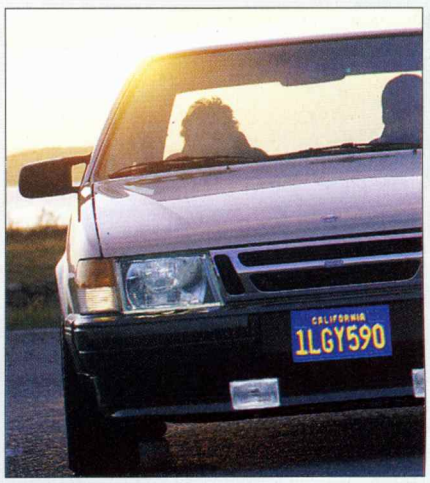
In cold weather

Let's assume that outdoor temperature is 15°F (–10°C) when the car is first started. Immediately the ACC switches on the defroster at low fan speed and keeps it there until the engine has warmed up. In addition the rear window heater and the external rear-view mirror heaters are switched on automatically.

As soon as heat is available from the engine, the fan speed will increase and the air flow will be distributed automatically to the defroster and floor, to heat the interior as quickly as possible. At the same time, the defroster continues to blow warm air onto the windshield.

When 74°F (23°C) has been reached, the automatic equipment will modulate the heater control, to maintain the right temperature. After 10 minutes, the rear window heater and the external rear-view mirrors will also be switched off automatically.





In hot weather

Let's asssume the outdoor temperature is 95°F (35°C) when the car is first started. Initially the ACC will start the air conditioner compressor and open the ventilation dampers. Cooling of the incoming air will now start very quickly, gradually also lowering the air temperature in the interior which may initially have been as high as 140°F (60°C).

When 74°F (23°C) has been reached, the air conditioner compressor will automatically be modulated to suit the cooling requirements. The air distribution and fan speed will now follow the program or can be selected manually.

For more economical motoring, the air conditioning compressor can be switched off manually. This is done by depressing the "ECON" button, and indication will then be provided by an LED.

The purpose of sound insulation is to create an acoustically comfortable environment in the interior —by attenuating undesirable sound, thus allowing the occupants to carry on a normal conversation and listen to music.

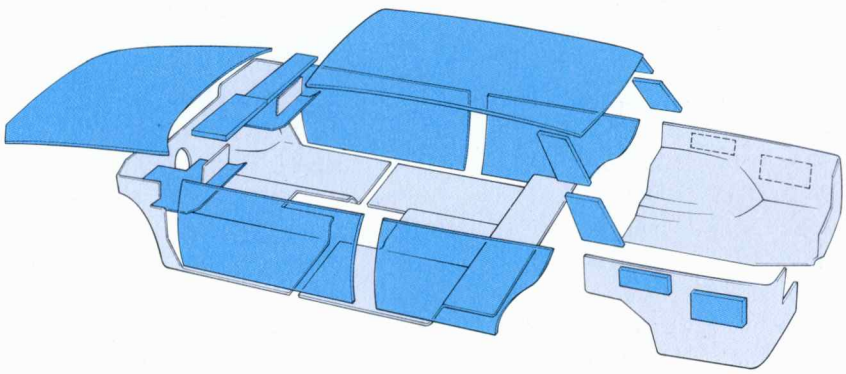
Sound attenuation

The material used for sound insulation attenuates mid-range and high frequencies. A low-weight material, with high capacity for attenuating structure-born sound, is used on the floor, wheel housings, doors and roof of the body to cut down the sound at its source. This insulation consists of a thick layer of material which is fused to the surface before the body is painted. A molded, multi-layer material is applied to the bottom front part of the body, to the floor, bulkhead and wheel housings. The different layers of this material have their specific characteristics, e.g. one resilient and one harder layer of plastic jointly attenuate the sound from the engine, gearbox, road and other sources. Porous absorbents of foam plastic or felt are used to reduce the sound level in the engine compartment and damp out resonance in cavities. These materials also reduce the sound emitted to the outside of the car.

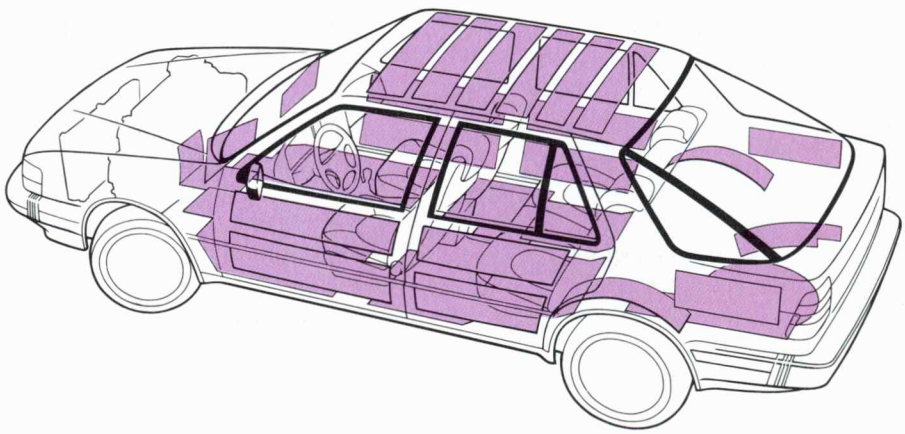
Sound can penetrate even very narrow joints. So extensive work has gone into to minimizing sound leakage through joints and penetrations. Sound-absorbent materials are also used for the ventilation and exhaust air ducts. The entire interior has been designed for optimum acoustics and will not muffle speech. Even the speakers for the audio system are located for efficient sound reproduction and optimum stereo effect.

The roof lining is of moulded fiberglass, which has good heat and sound insulating properties, is flame-retardant and provides effective impact absorption.

In the Saab 9000 CD, acoustical comfort is further enhanced because the sedan body construction, with its fixed rear seat and parcel shelf, adds increased structural rigidity in the rear section, lowering vibration and offering excellent road isolation. In addition, an entirely new type of acoustical insulation separates the passenger compartment from the engine, and insulation completely surrounds the trunk. This added sound dampening, in combination with built-in sound traps, also contributes to the 9000 CD's acoustical comfort.



Porous sound absorbents consist of foam plastic, felt and similar materials. They are used in the engine compartment and also to damp out resonances in the body cavities and in the interior.



Thick insulation matting is fused to the floor and wheel housings before the body is painted. Frame sound-insulating material is applied to all sheet-steel surfaces that are susceptible to vibration.

Comfort

Driver's seat of sound anatomical design and with many adjustment facilities:
- A very wide range of individual adjustments.
- High driving comfort.
- Exceptional comfort on long journeys.
- High passive safety.

Ergonomic design of the instrument panel:
- Highly adaptable to individual requirements.
- Instruments designed for fast and reliable reading.
- Very comfortable and safe driver's environment.
- High comfort on long journeys.

Logical location of instruments and controls:
- Easy to find and use.
- Prevents errors in critical situations.

Clear, international symbols, including pictogram, for checking certain safety functions:
- Easy-to-understand indications.
- Monitors the external lamps and warns the driver of improperly shut doors.

Classified as a "Large Car" according to the U.S. EPA standards:
- Inside dimensions are comparable to the largest cars on the market.
- Very generous legroom in the back seat.
- Airy interior, good outward visibility.
- High overall comfort for the driver and passengers.

Exclusive design and materials in the interior:
- Create a high-quality atmosphere.
- Are dimensionally stable and durable.
- Have an inviting appearance.

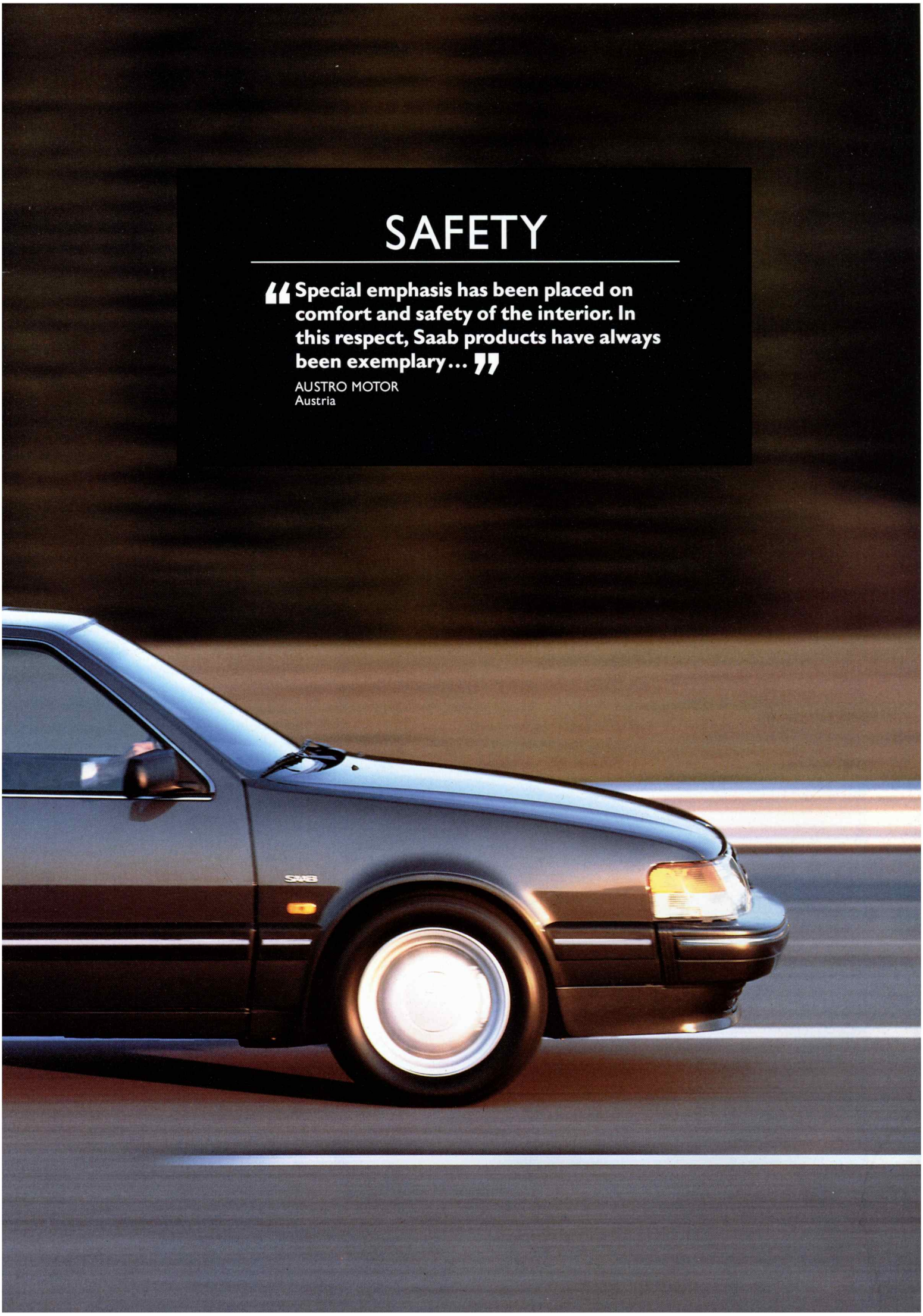
High-quality spring-interior cushion for the back seat:
- Excellent seating comfort.

Manually adjustable heating of both front seats:
- Contributes to high comfort and safety.

Extensive insulation of the floor, roof, doors, bulkhead, etc.:
- Low sound level (road noise, engine sound) for optimum comfort.
- Excellent acoustics.

Advanced design, with automatic control and high capacity for heating, ventilation and cooling:
- High heating capacity.
- Fast heating.
- High ventilation capacity.
- Automatic system with manual override facilities (Turbo models).
- Stratified air flow.

Ventilation air filter:
- High-efficiency cleaning of the ventilation air.
- Reduced road dust and effective protection against oily deposits on the inside of the windshield.
- Reduced discomfort for people suffering from allergies and asthma.


SAFETY
“Special emphasis has been placed on comfort and safety of the interior. In this respect, Saab products have always been exemplary…”
AUSTRO MOTOR
Austria
SAAB

The Saab 9000 is the safest car on the market. That's the opinion of Folksam—Sweden's largest insurance company—after having studied 900 000 road accidents.

Dr. Claes Tingvall, safety researcher at Folksam, comments: "If people only knew the wide differences between the safety of different cars, proven behavior in a collision would become a decisive factor in their choice of car."

Safety

The Saab 9000 has been designed to prevent, as far as possible, accidents from occurring in the first place— that is, for *active safety*. Consistent driving characteristics contribute to active safety, as do effective brake systems, front-wheel drive, directional stability, and an ergonomic interface between car and driver.

No matter how highly active safety is developed, of course, an accident may still occur. So the body and interior of the Saab 9000 have been designed for collision protection of the occupants. This protection defines *passive safety*.

Passive safety is enhanced through close cooperation between Saab engineers and a team of medical specialists who analyze the causes and effects of actual accidents. Their conclusions allow us to constantly improve the safety standards of all Saab cars.

The design of the body and interior of the Saab 9000 plays an important part in passive safety. There is, for example, a generous amount of room between passengers and the heavily padded interior fittings in order to minimize risk of injury.

"... Nobody should doubt the ability of the 9000 to cruise rapidly in safety and relaxation, or to cope with urgently high-speed progress along winding roads with indifferent surfaces."

AUTOCAR
Great Britain

Seat belts

Seat belts are standard equipment for all five occupants of the Saab 9000. The seat belts for the front occupants and the outer two passengers on the rear seat are of the three-point, inertia-reel type. A lap belt is provided for the center passenger.

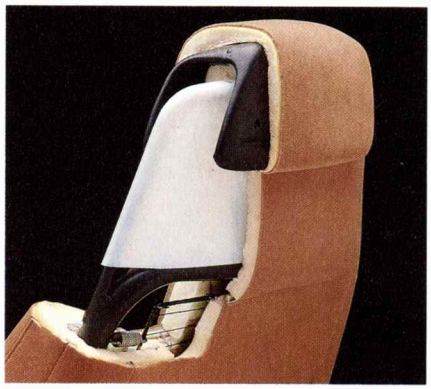
Since the bottom anchor points of the front seat belts are secured to the seat, they will move with the seat on fore-and-aft adjustment. This adjustment can easily be carried out even when the occupant's seat belt is fastened. The anchor point on the door pillar is vertically adjustable in four steps. This enables the occupant to adjust the strap to a comfortable position.

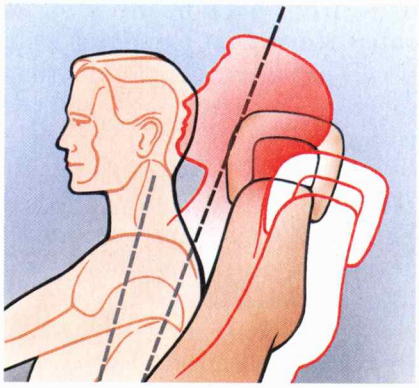
The effectiveness of the front seat passenger's seat belt has been enhanced with an automatic seat belt tensioner. In a collision of sufficient force, a device tightens the belt almost instantaneously, thus eliminating any slack that might otherwise reduce the belt's effectiveness.

In order to obtain full collision protection, *all* occupants must wear their seat belts. Crashing into a solid obstacle at 30 mph is approximately equivalent to falling from a third-floor window. The seat belts are designed to restrain and protect occupants in both primary and secondary impacts.

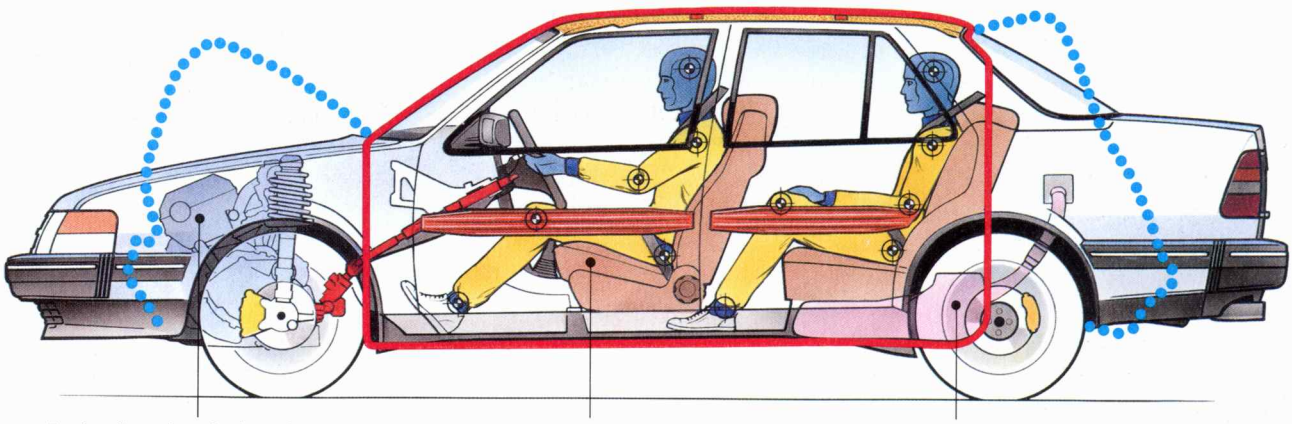
Head restraints

In a rear-end collision, the seat backs must rapidly absorb the reverse impact of occupants' heads and bodies, particularly the whip-





The front seats are equipped with adjustable head restraints. Tests have proven that, when properly adjusted, the head restraints effectively protect the occupants' neck vertebrae in front and rear collisions.



Engine location designed to absorb collision forces and protect the interior

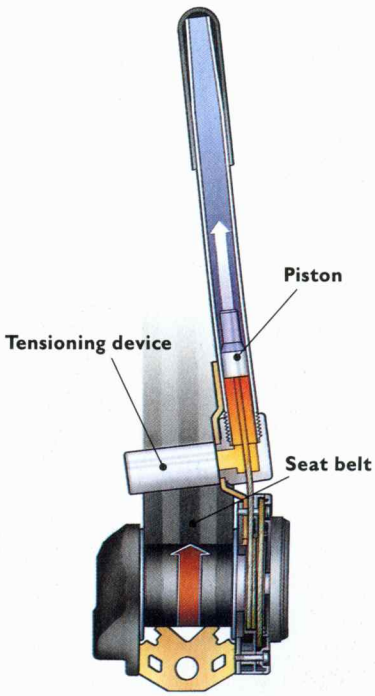
Front seats with "anti-submarining" protection in a collision

Fuel tank located forward of the rear axle and between the rear wheels

Saab's unit-body construction of heavy gauge steel creates an overall energy absorbing "safety cage".

The bottom anchors are secured directly to the seat and are thus self-adjusted with the seat.

Adjustable top anchor points for the front seat belts.



The automatic belt tensioner further improves the effectiveness of the front seat passenger's seat belt. In a collision of sufficient force, a device tightens the belt almost instantaneously to take up any slack.

lash effect. Therefore the front and outer rear seats are fitted with strong head restraints, built up on sheet-steel frames and covered with dense foam padding.

Impact-absorbing surfaces

The whole interior is heavily padded, and free of sharp edges and hard surfaces. The top and bottom sections of the instrument panel are backed by dense, molded polyurethane foam. The spaciousness of the interior, with generous room between front passengers and instrument panel, considerably reduces the risk of impact injuries. The steering wheel also has a thick, padded rim.

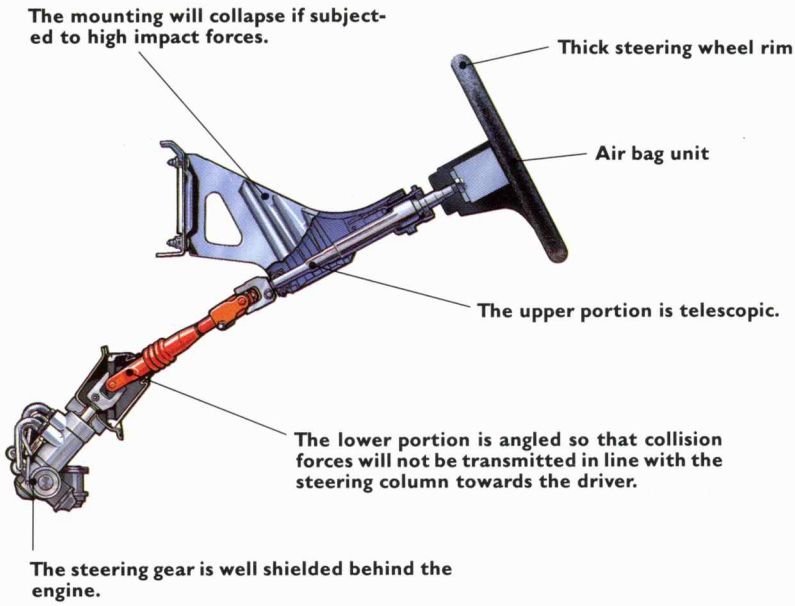
Safety steering column

The three-section steering column is designed to collapse in stages in a frontal collision. The upper section is telescopic and the lower section is jointed and fitted with a patented Saab sheet-metal bellows that collapses under abnormal stress. The steering gear is located low and far back in the engine compartment, so that it is well protected by the engine itself in the event of a frontal collision.

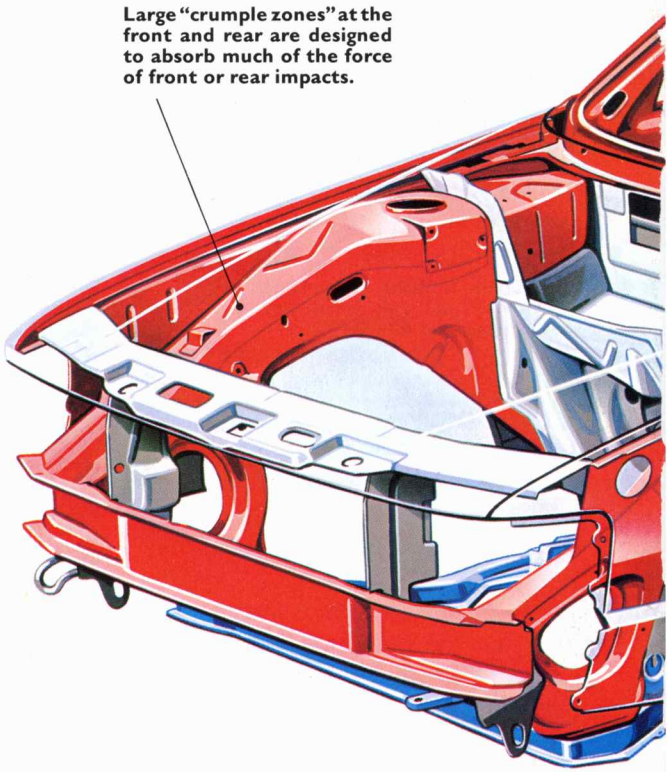
Safety cage

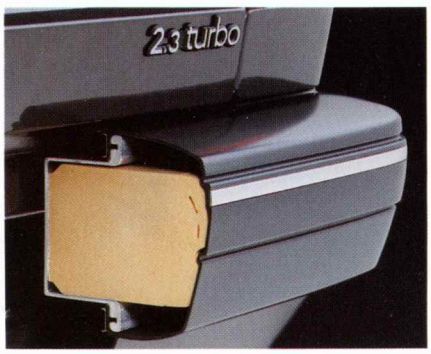
Saab's unit-body construction of heavy gauge steels provides occupant protection through large front and rear "crumple zones" and side reinforcement, creating an overall energy absorbing "safety cage".

The computerized design has been tested for safety under realistic conditions. Saab tests demonstrate that large "crumple zones", reinforcing door members and the appropriately strong body structure absorb the collision forces, helping to maintain the integrity of the passenger compartment. Driver and passengers thus are exceptionally well protected.


The mounting will collapse if subjected to high impact forces.
Thick steering wheel rim
Air bag unit
The upper portion is telescopic.
The lower portion is angled so that collision forces will not be transmitted in line with the steering column towards the driver.
The steering gear is well shielded behind the engine.

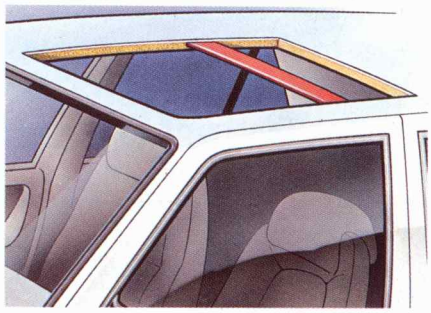
The Saab 9000 steering column is designed to collapse progressively in a frontal collision.



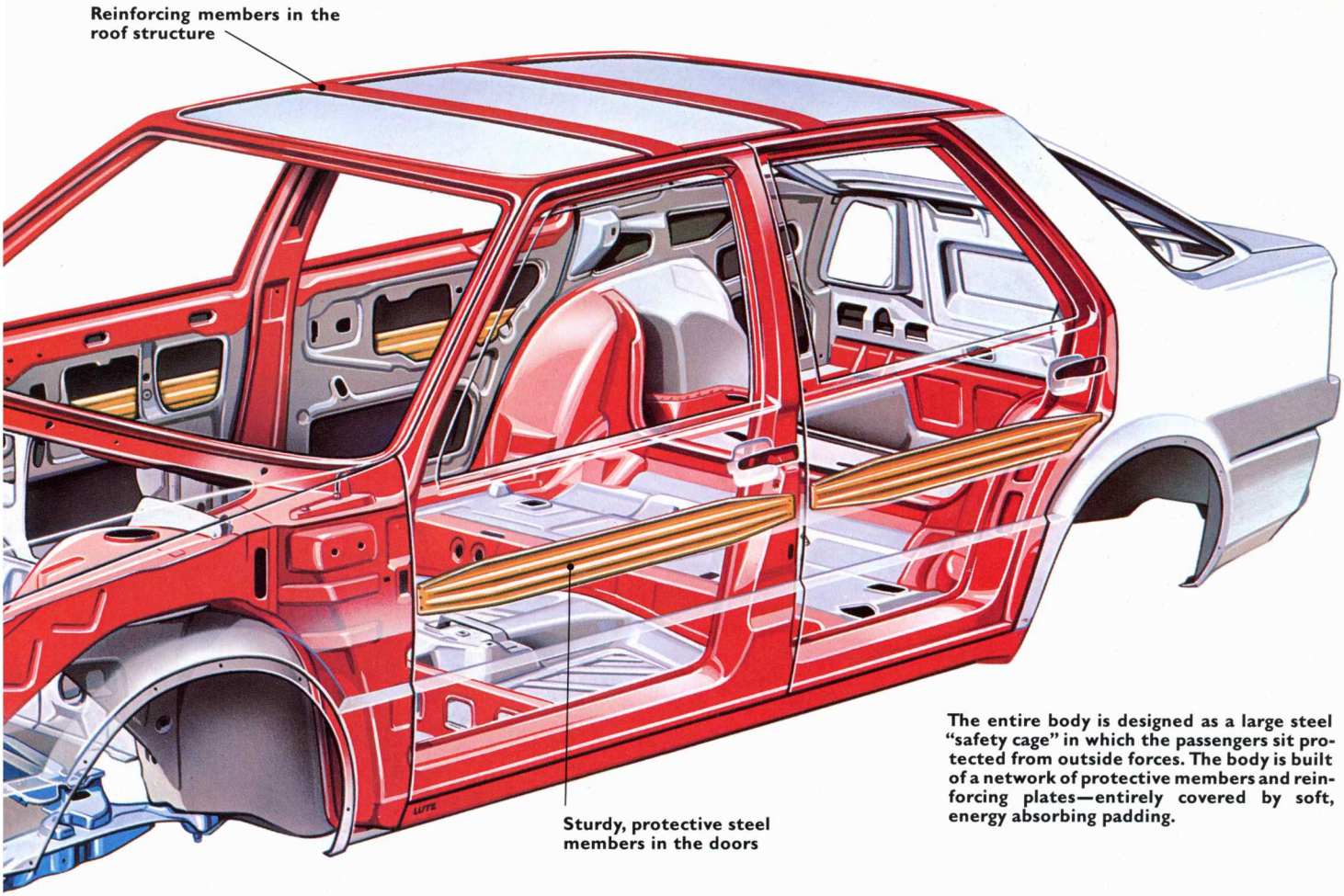


The impact-absorbing bumpers are filled with a resilient foamed material so they resume their original shape after minor impacts.

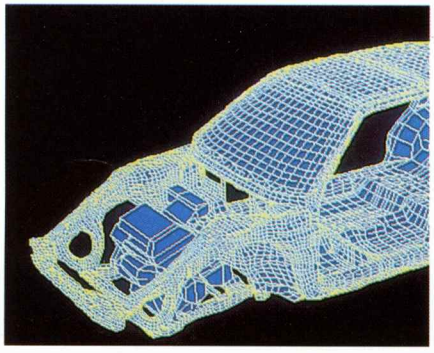
The sturdy reinforcing members in the doors provide effective protection in side impacts.



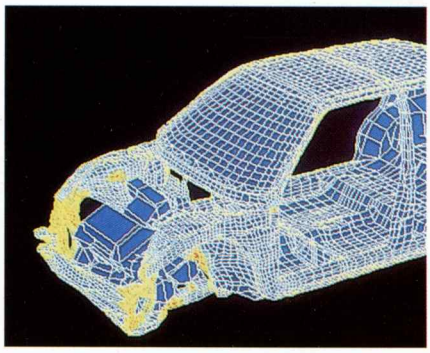
The roof lining of molded glass fiber material provides effective impact absorption.



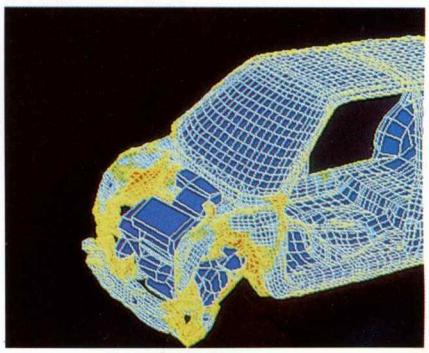
The entire body is designed as a large steel "safety cage" in which the passengers sit protected from outside forces. The body is built of a network of protective members and reinforcing plates—entirely covered by soft, energy absorbing padding.



The collision process is simulated in computers, so that a number of alternatives can be evaluated before being confirmed through...



... tests on actual cars. The illustrated sequence shows how the Saab 9000 body crumples when it hits a solid barrier at 30 mph....



... The first picture corresponds to the instant of collision; the second and third show the results 20 and 40 milliseconds later.

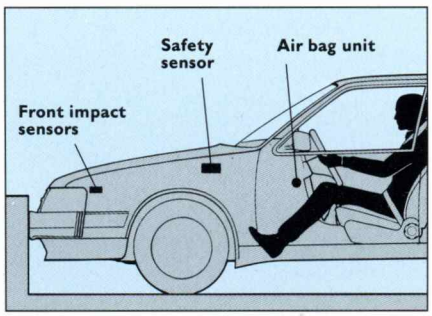
Saab was a pioneer in the installation of three-point safety belts in the front and rear. Now, every new 9000 model also provides the extra protection of the Saab Supplemental Restraint System—SRS.

Supplemental Restraint System

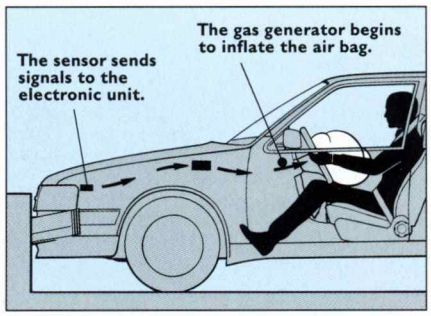
The Saab Supplemental Restraint System (SRS) provides added protection for the front seat occupants in the event of a severe frontal collision. The Supplemental Restraint System is most effective when both front seat passengers are wearing their seat belts.

The SRS incorporates an air bag module in the center of the steering wheel for the driver, a seat belt tensioner for the front seat passenger, padded knee bolster for both front seat occupants, a control unit with built-in diagnostic capabilities and two impact sensors located in the engine compartment, forward of the front wheel housings. These sensors relay impact information to the electronic control unit, which includes a third, "safety" impact sensor.

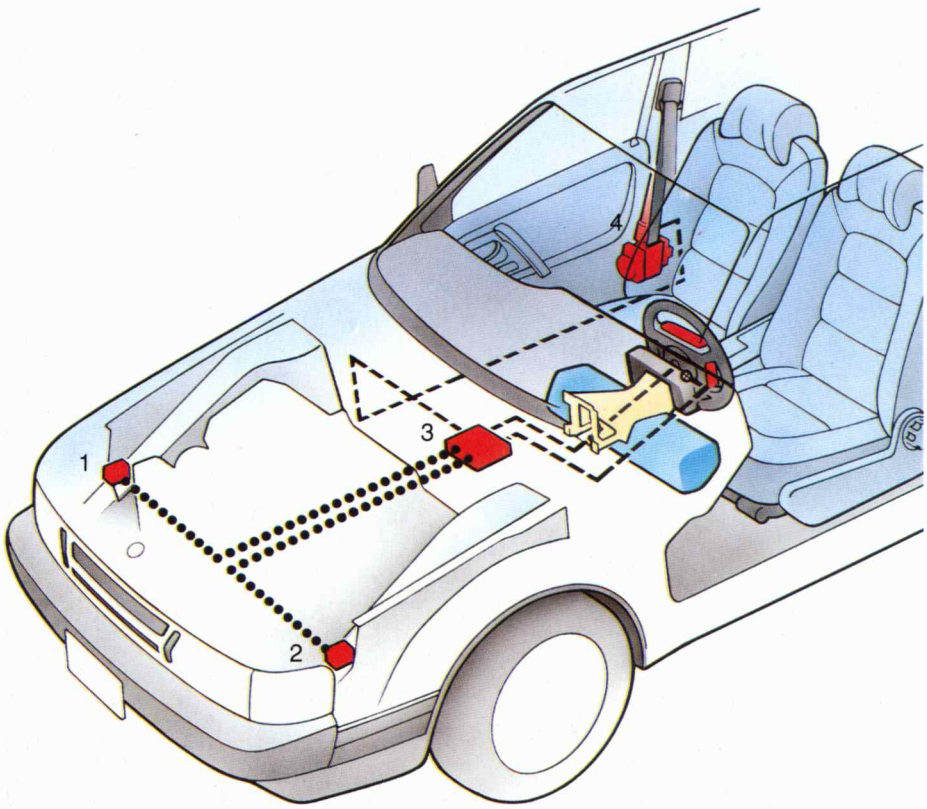
Cars with the SRS are identified by the letters SRS on the center pad of the steering wheel. In addition, there is an SRS service indicator lamp in the pictogram display section of the instrument panel. This pictogram will light up for about 6 seconds when the ignition switch has been turned to the "on" or "start" position, to provide a check that the system is operative.



This picture shows the instant of impact.



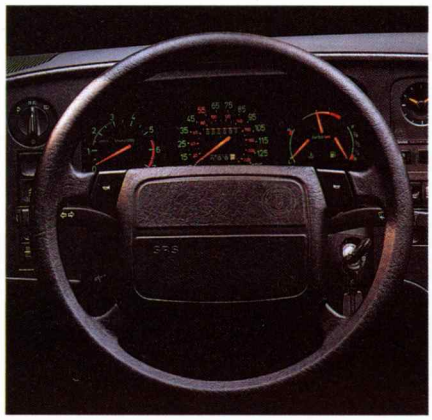
20 milliseconds have elapsed since the moment of impact. The sensors have tripped and the driver's side air bag has started to inflate.



At least one of the two impact sensors (1 and 2) and the safety sensor in the control unit (3) must trip before the driver's side air bag deploys. Simultaneously, the seat belt tensioner (4) will automatically tighten the passenger's seat belt.

Effective supplement

If a frontal collision should occur either head-on or across a 60 degree arc in front of the car, and at a speed higher than approximately 10 mph (with a retardation force of at least 16 g), one or both of the front sensors will trip and apply a signal to the electronic control unit. As the collision progresses,

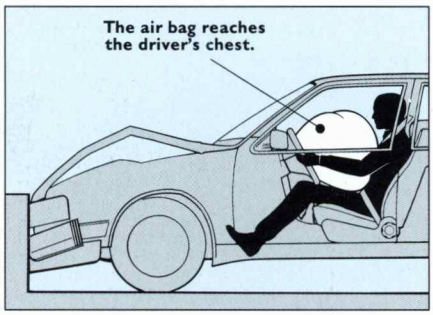


The letters "SRS" embossed in the steering wheel indicate that the car is equipped with the Saab Supplemental Restraint System.

the impact forces will be absorbed by the special "crumple zones" at the front of the car.

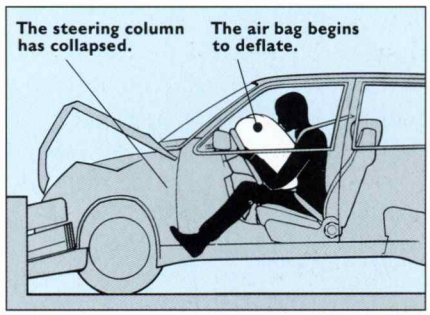
The safety sensor inside the control unit will trip at a retardation force of around 2 g. This will cause the air bag to deploy in 20 to 30 milliseconds, cushioning the driver from impact.

At least one of the front impact sensors and the safety sensor must both trip before the Supplemental Restraint System will be activated. The SRS will not be actuated in a minor frontal collision, a rollover, or a side or rear collision.

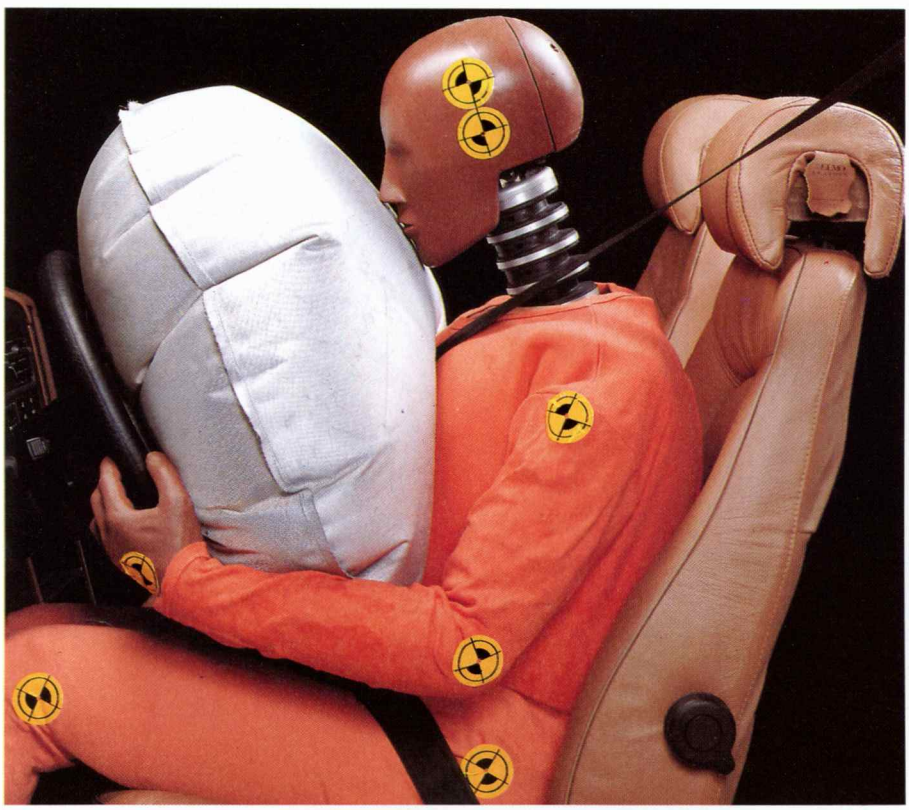


At 23 milliseconds, the air bag reaches the dummy's chest. About half of the car's "crumple zone" is now compressed. The dummy has not yet started to move forward in the interior.

40 milliseconds after the instant of impact, the air bag is almost totally deployed. Most of the "crumple zone" is now compressed. At this time, the dummy begins to move forward as a result of the impact.



70 milliseconds have elapsed since the instant of impact. As the air bag absorbs some of the load transferred by the impact of the dummy, the gas within the air bag will be discharged through the vent openings. In this manner, the dummy's forward motion is retarded in a controlled fashion which minimizes injury potential. But once deflated, the role of the air bag in occupant protection is over.



The Supplemental Restraint System is designed to provide maximum protection for front seat occupants wearing seat belts. The driver's side air bag is not a substitute for a seat belt.

In addition to the safety impact sensor, the electronic control unit contains a self-diagnostic unit for the Supplemental Restraint System. The control unit is also equipped with a self-contained capacitor pack, which provides power for the system even if the car's electrical system should be damaged in the collision.

The Supplemental Restraint System is just that—supplemental. The air bag component is not intended to replace the primary restraint system—the seat belt. For maximum protection and safety, all occupants must wear their seat belts. The use of a seat belt is important in offering optimum restraint and protection from the force of impact. Moreover, the use of a seat belt provides restraint in a subsequent collision after the initial impact, or in a non-frontal collision, in which the air bag is not designed to deploy.

Safety

Active safety:
- Minimizes the risk of accidents.
- "Forgiving" handling characteristics which "correct" minor driving errors instead of amplifying them.
- Safe, steady road behavior.
- Consistent handling behavior.
- Anti-lock braking system.

Passive safety:
- Minimizes the risk of injury.
- Sturdy, steel safety body.
- Computer-aided body design, tested in the laboratory under realistic conditions.
- Large "crumple zones".
- Sturdy, protective steel members.
- Heavy padding throughout.
- Gradually collapsible steering column.
- Three-point inertia reel seat belts for outboard occupants, front and rear (require manual fastening).
- Lap belt for rear center position.
- Saab Supplemental Restraint System with driver's side air bag.
- Emergency tensioning seat belt retractor for the front passenger.
- Head restraints of safe design.
- Roof lining of molded glass fiber material provides effective impact absorption.
- Well-protected location for the fuel tank.
- Overall design that minimizes the consequenses of an accident.

turbo
ABA 153

2.3-16

QUALITY

"... The Saab 9000 appears to be the fully-fledged result of all modern technology... it has pleasing lines and very convincing performance... certain level of quality in production and presentation, which has placed Swedish cars in a slightly different niche from the others..."

L'AUTO-JOURNAL
France

Many years of methodical design, testing and refinement have been invested in the creation of the Saab 9000. A vast amount of work has been done even on the parts you will never see. New assembly and inspection processes have been developed as well. The goal of all this care and attention is to ensure the performance and durability of the Saab 9000 for years of driving pleasure.

Research and development

Over the decades, Saab has done its utmost by tests in the laboratories and out on the roads to assure the Saab owner of trouble-free motoring. "The long run" endurance test demonstrated how well Saab designers and production engineers have succeeded.

"The long run" event was run in 1986 on the world's fastest race track in Talladega, U.S.A. Three perfectly standard Saab 9000 Turbos were sealed at the factory to prevent tampering, were transported to the track and were then driven non-stop, day and night, for 20 days at full throttle—under the supervision of the FISA international motor sport authority. All three cars had covered a distance of 100,000 km (62,000 miles) when they crossed the finish line. They recorded average speeds between 132.5 and 129.7 mph (213.3–208.8 km/h), including pit stops for refueling, driver changes and service. In "The long run", the Saab 9000 won no less than 21 international speed records in endurance motoring—including two world records. A resounding accolade for the durability and quality of the car.

Advanced technology

Saab car designers have had the benefit of the advanced facilities available at the Saab-Scania Aircraft Division—above all, the Cray supercomputer. This provides the means for simulating complicated events, such as the flow of air around the body of a car, or the deformation of the body—microsecond by microsecond—in a collision.

Many alternatives can be evaluated by such simulation before the best of them are released for further practical tests on prototype cars. Collision simulation takes several days on a conventional mainframe computer, while the Cray computer does so in only a few hours.

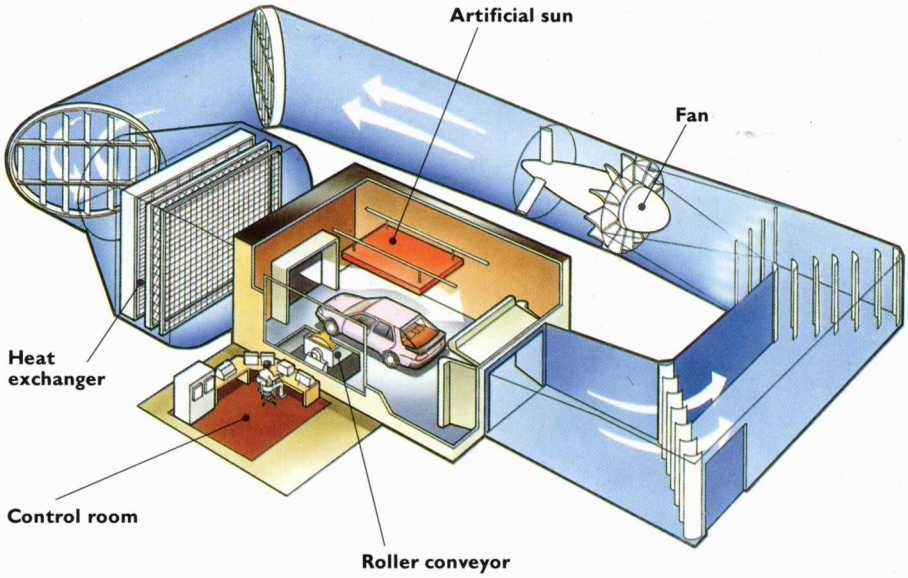
Lightweight but strong structures have long been vital to aircraft. The plastics and composites evolved for this purpose are now making rapid inroads into cars. The electronics content of cars has been growing at a tremendous pace.

It is essential that the systems incorporated in a car function reliably for the entire working life of the car. So Saab produces in-house a large share of the electronics used in its cars. The experience gained from the aircraft and aerospace engineering operations of the Group provides a firm foundation for this work.

Alabama International Motor Speedway at Talladega, USA was used for these record-breaking runs.

Three completely standard Saab 9000 Turbos, selected randomly off the production line, set the international records.

The cars were driven essentially non-stop at full throttle for 20 days and nights and covered 62,000 miles (100,000 km) each.

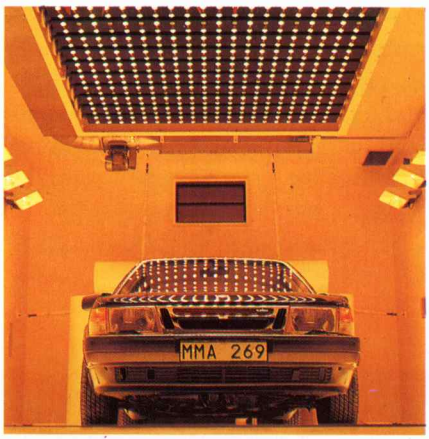


Almost any conceivable set of climatic conditions can be reproduced in Saab's climate wind tunnel, which provides airflows at up to 94 mph (150 km/h).

Modern development laboratories

The step from fundamental technology to practical tests on prototypes obviously varies widely between new cars and new aircraft. Saab has therefore established its own modern development laboratories that include a wind tunnel in which the climate can be varied from arctic cold to tropical heat. The tunnel also has facilities for generating light which is as intensive as ordinary sunlight.

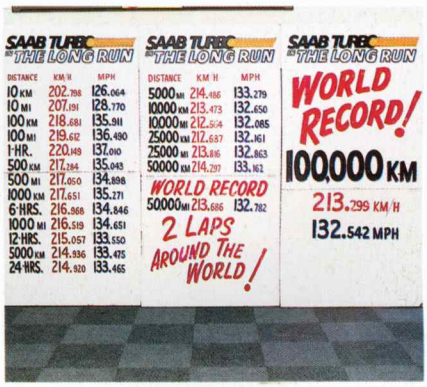
Another example is the Saab acoustics laboratory in which cars can be tested under all conceivable simulated conditions. Sound and vibrations can be recorded while the car is travelling at over 110 mph on dry tarmac, or while it is towing a trailer up a 12° gradient on an unpaved road. Even the flow of air at the required temperature can be simulated at road speeds of up to 94 mph.



Saab 9000 is built for all climates from arctic cold to the torrid heat of a desert road.

Each driver drove for 2 hours at a stretch, but the cars never relaxed—they went on for 3 weeks, with only pit stops for refueling and normal servicing.

The fastest car maintained an average speed of 132.5 mph (213.3 km/h)—the slowest 129.8 mph (208.9 km/h)—including pit stops!



The outcome was 21 new international records.

From the moment you take your seat, you'll begin to appreciate the qualities that make a Saab 9000 unique.

Production quality

The Saab 9000 is built in factories where technology and work load distribution provide optimum conditions for the production of a high quality end product.

Heavy work, such as pressing and welding sheet metal, is automated to the maximum. Robots and automatic welding machines return uniformly high quality results.

Work load distribution

The Saab 9000 is assembled by autonomous groups responsible for both fitting and inspection. No car or component leaves group territory without being carefully inspected and approved.

The work load distribution system brings advantages to mass car production previously enjoyed only by handbuilt car makers.

One example of this is the power unit which includes the radiator assembly, the front section with headlamps, the steering system and the front suspension. The unit is pre-assembled onto a separate subframe by one or two fitters. Once inspected and approved they fit it into the body. The system of several fitters working in parallel is applied to most aspects of building the Saab 9000, obtaining far better results than those of conventional assembly lines.

No car or component leaves the assembly group area before being inspected and approved.

Control

The Saab 9000 is rigorously tested on a long list of points before leaving the factory. Each assembly stage and, finally the complete car, are subjected to careful inspection. Here is an example:

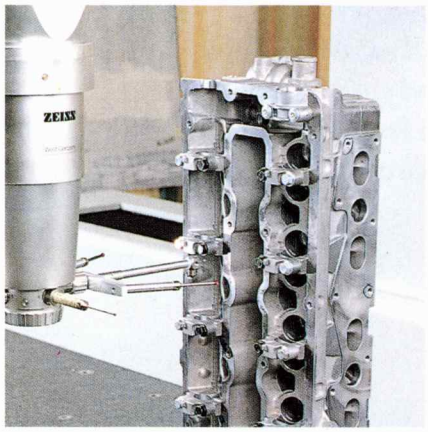
Engine quality control

Saab engines are made in Södertälje. This production site goes back a long way, engines first being built there in 1897. For the Saab 2.3 liter engine family, a brand new, highly automated manufacturing facility was opened in 1989.

Today all engines have to be tested and approved before they leave the factory.

Engine quality first becomes apparent after tens of thousands of miles. In the laboratory the quality can be determined within a very short space of time. Saab engines are required to measure up to very narrow tolerances, one of the reasons why Saab engines are so durable.

Some part of production is always under quality audit, a process applied to both incorporated com-



A cylinder head is measured in a coordinate reading machine. Approximately 400 readings are taken from each cylinder head during the automatic measuring program.

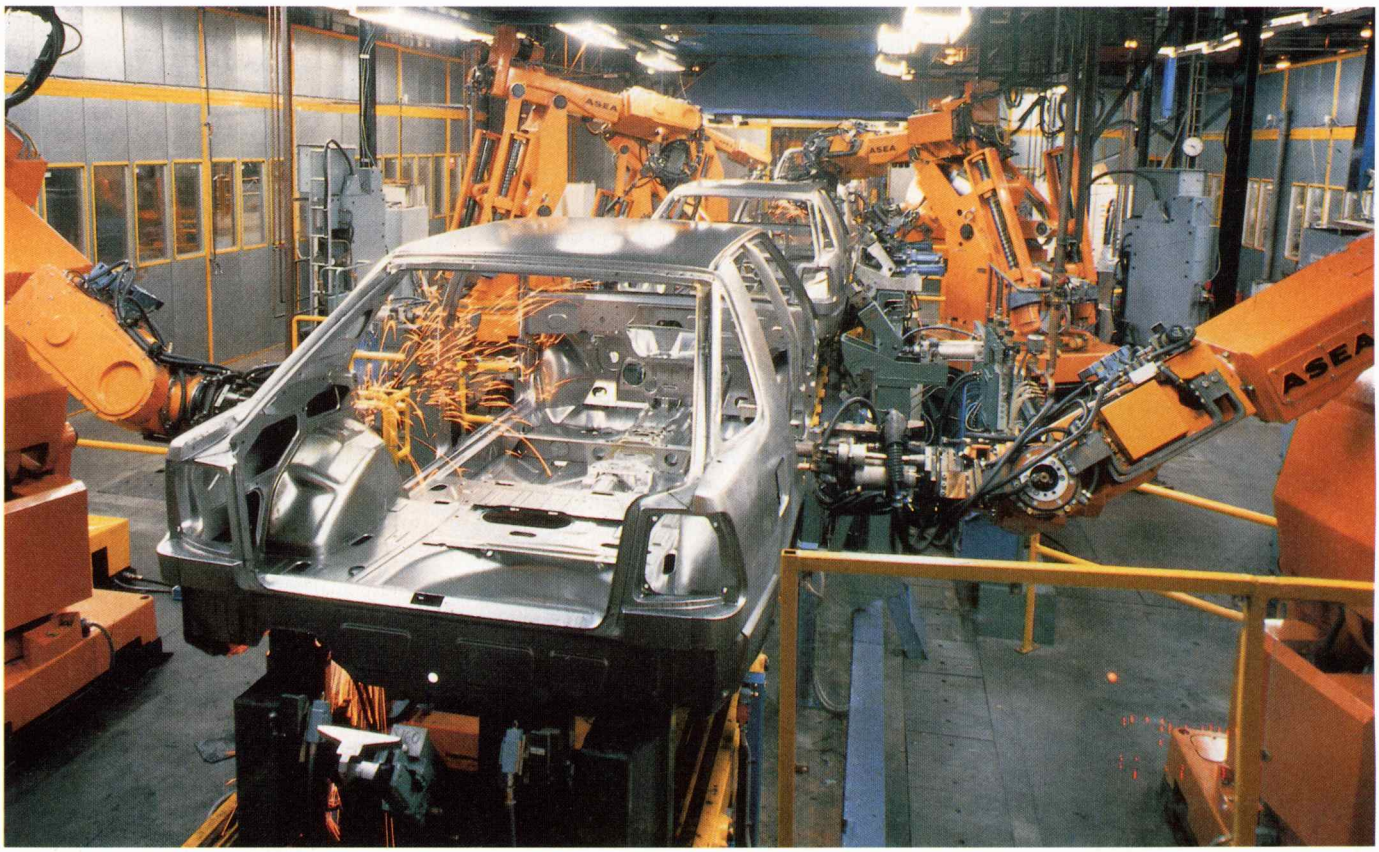
Each engine is test driven before leaving the factory. Functions and settings are checked.

ponents and complete engines. During these inspections all component or complete engine specifications are checked. The cylinder head, for example, is checked at approximately 400 different points. A complete engine inspection entails measuring power output, fuel consumption and a number of other parameters after which the engine is dismantled into its essential parts. During dismantling all dimensions, clearances and tightening torques are measured and noted. A total of approximately 300 points are documented.

Should a deficiency be discovered, the person responsible for that particular stage of production is notified and production corrections are made accordingly.

All quality audit results are documented and statistically processed in order to measure and improve long-term quality.

Once fitted to the car the engine is tested yet again. Each car is driven onto a "rolling road" for a comprehensive program. Engine, transmission and brakes are put through their paces by experienced test drivers assisted by diagnostical instruments.



Saab runs one of the world's most robot automated factories. Robots help to maintain high, even quality levels.

The establishment of good anti-corrosion characteristics must begin when a car is being designed. Thus the Saab 9000 has a monolithic underbody, with no pockets to accumulate dirt or moisture. The front wheel housings have plastic wheel-arch linings that provide efficient protection from splashed material.

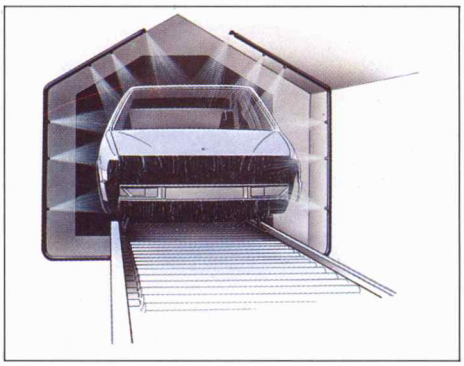
Anti-corrosion measures

Protection against corrosion is very advanced on the Saab 9000. One example is that the body is produced from a small number of large units, to restrict the number of welds to a minimum. The welded joints are located in such a way and raised to such a level that they will not be exposed to abrasion, moisture and corrosion. Large parts of the body and chassis are galvanized or hot-dip galvanized to withstand corrosion. Pockets that may accumulate dirt or moisture in the underbody have been eliminated.

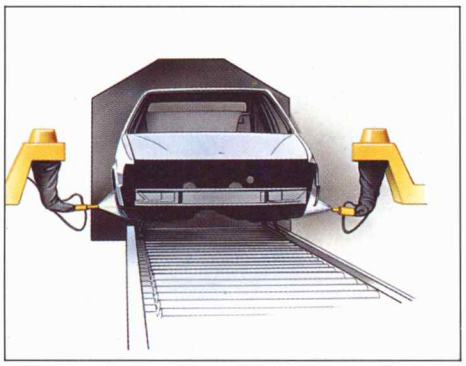
A unique Saab design feature is that spacer washers are used for securing many chassis components to the body. These washers prevent abrasion of the paintwork and the anti-corrosion treatment. If a component is ever replaced, this feature eliminates the risk of bare metal surfaces being exposed under the component. Further, there is no need for subsequent treatment, such as repainting and touching-up of the rustproofing after a component has been replaced.

The primer is applied electrostatically by immersing the body in a bath of paint, which ensures a thicker coat and better penetration than that provided by conventional methods of painting, particularly across the sheet metal edges. Computerized control is used for spraying anti-corrosion oil into the cavities of the body—in adequate quantities and correctly distributed. A polyester compound is applied to the entire underbody for protection against wear. Extra thick layers effectively protect against stone chippings. Triple protective coats are provided in the welded joints. Wheel housing liners are provided as protection against grit thrown up by the driven front wheels.

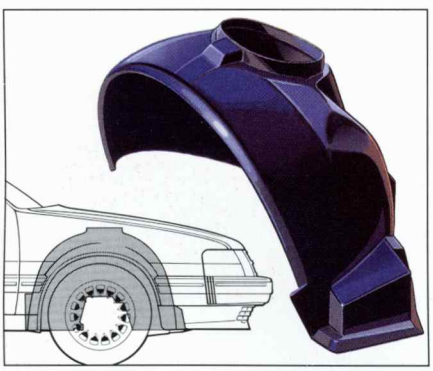
The paint is sprayed by robot, which ensures a uniform and high-quality surface finish, with controlled quantities and paint distribution. After spraying, the paint is cured in an oven, which produces a strong coat that will last for many years without losing its gloss.



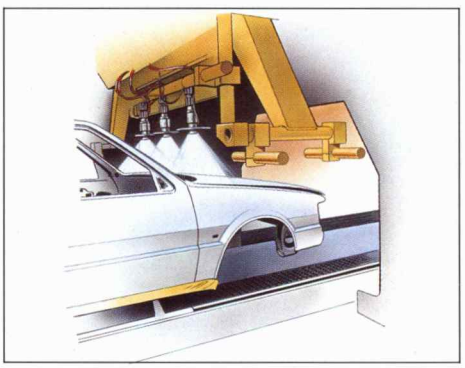
1 **Nine stage alkaline degreasing and zinc phosphating process provides basic protection and ensures good primer adhesion.**



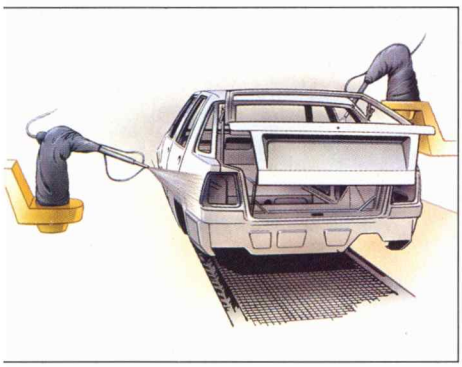
5 **The underbody, wheel housings and surfaces below the mid-line of the body are high-pressure sprayed with polyurethane compound. This provides homogeneous protection without blisters—and thereby reduces the risk of flaking. The polyurethane compound adheres very firmly, and after curing in an oven becomes a tough, very hard-wearing surface.**



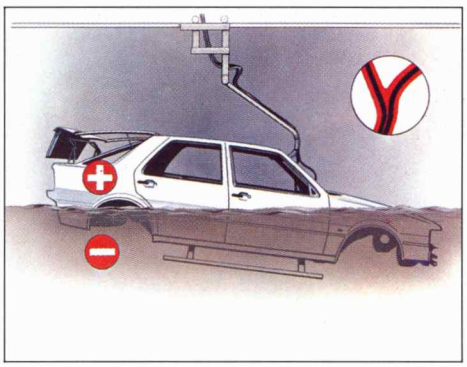
Several layers of protective coating and corrosion-protection coating in all cavities and members provide the Saab 9000 with very effective corrosion protection. Plastic wheel-arch linings provide protection from material splashed by the front wheels.



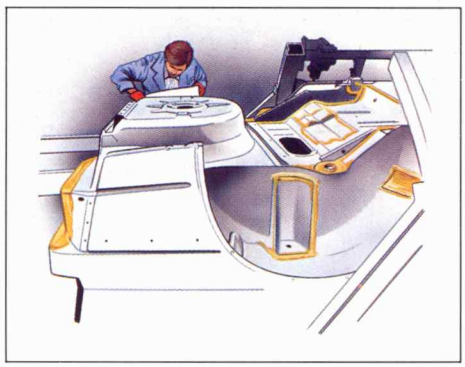
9 **The intermediate coat is wet rubbed. The top coat is applied and dried in an oven. Metallic finish is applied in two layers: a first coat of high pigment content, followed by a thick coat of clear varnish to protect the pigment and produce a very high lustre.**



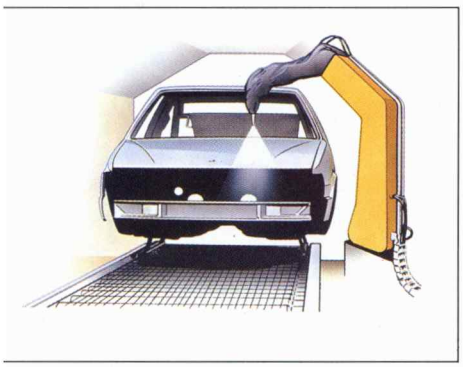
2 Body exterior treated with epoxy primer for effective protection from flying stone chips and corrosion.



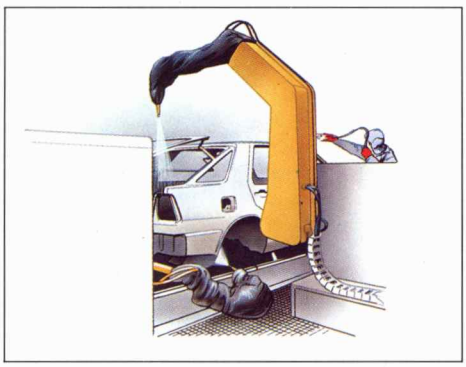
3 Bath of anti-corrosion primer. Powerful electric current ensures that the primer adheres to all internal cavities and surfaces. Body design allows the primer to penetrate to the most inaccessible areas. The result is an unbroken and uniform layer throughout, including all corners and edges.



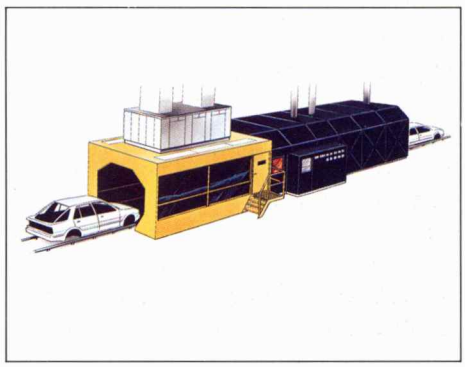
4 Joints sealed with PVC compound to prevent moisture penetration.



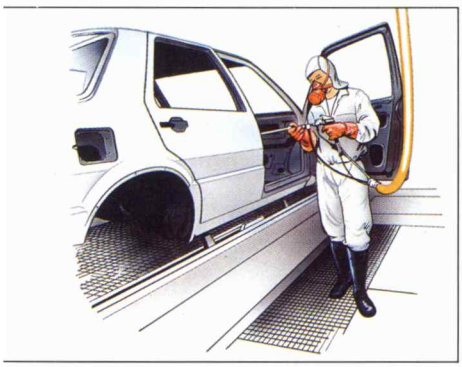
6 The majority of body painting is completed by computerized robots.



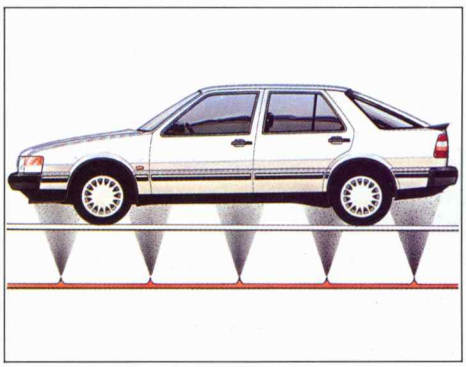
7 The entire body is sprayed with a coat of modified epoxy paint, which provides protection from corrosion and a good base for the top coat.



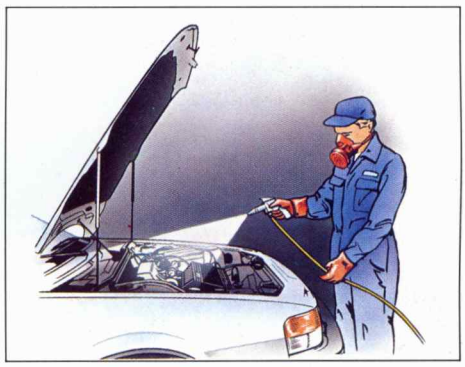
8 The painted surfaces and underbody are stoved to provide a base for the top coat.



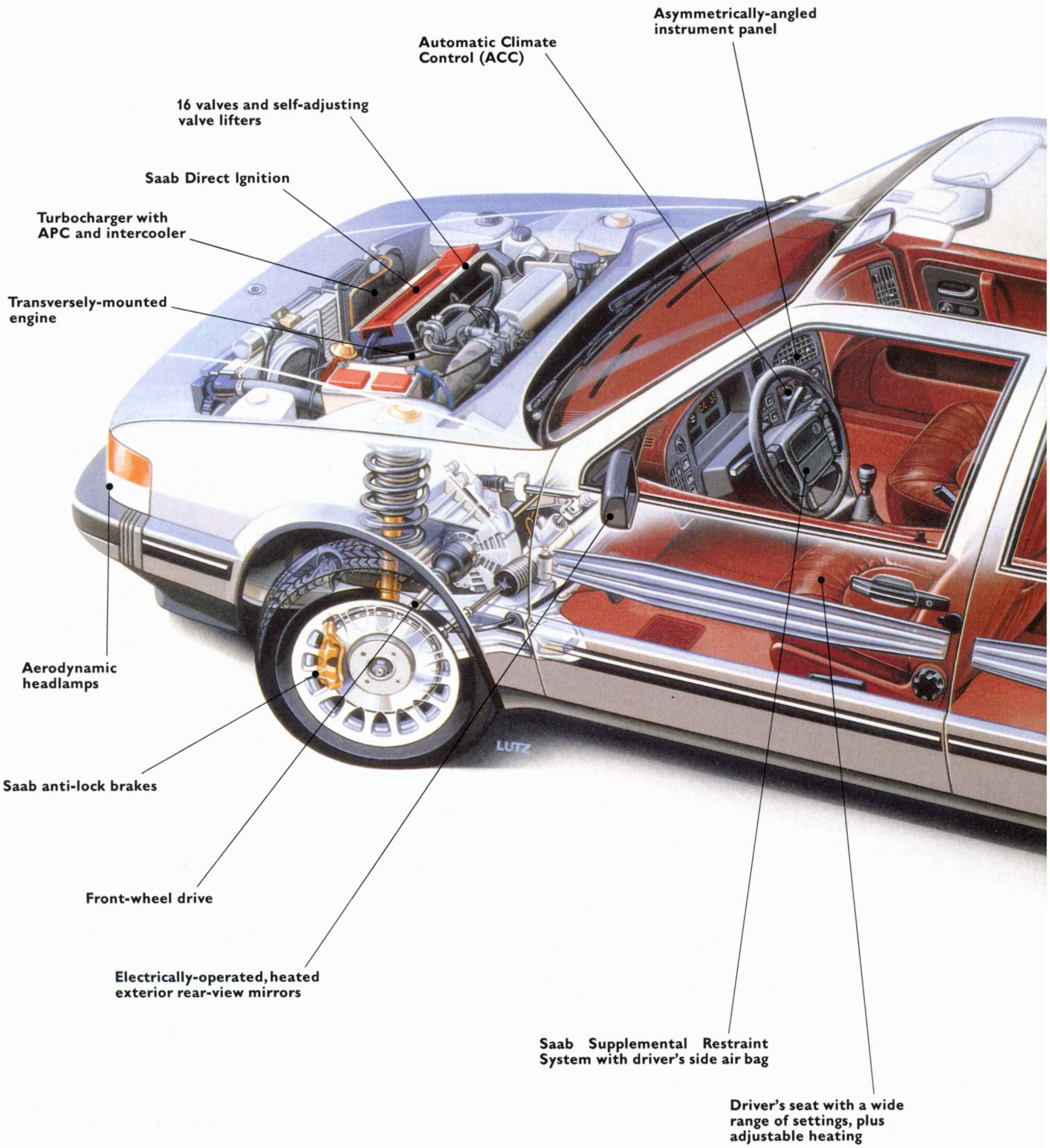
10 Anti-corrosion agent is sprayed into all cavities and joints: into sills, doors and brackets. A total of 160 places. After which the body is heated in an oven to ensure complete penetration of all joints by the anti-corrosion agent.



11 Some underbody components, fitted to completed cars after anti-corrosion treatment has been applied, are sprayed separately with the same agent.

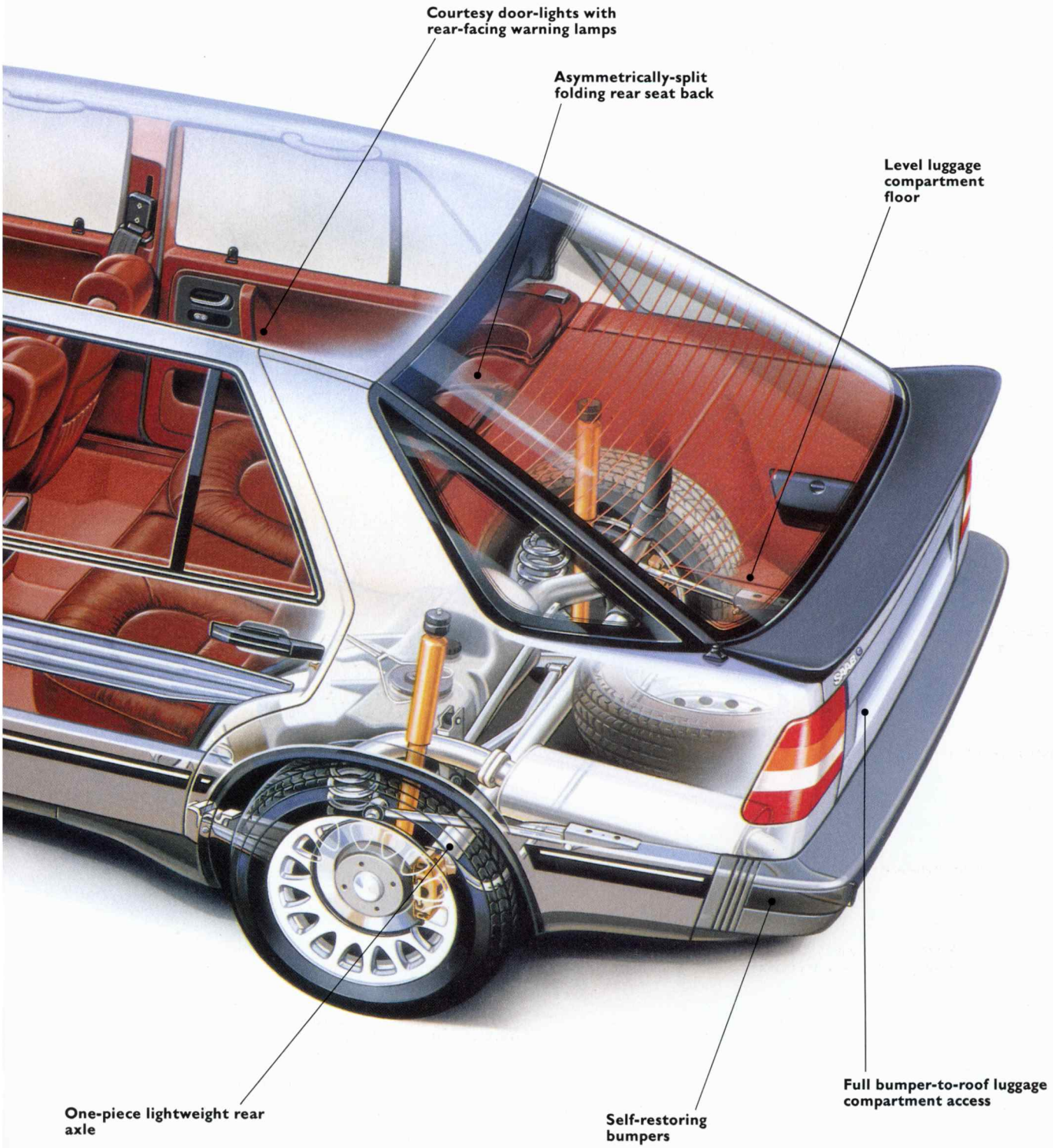


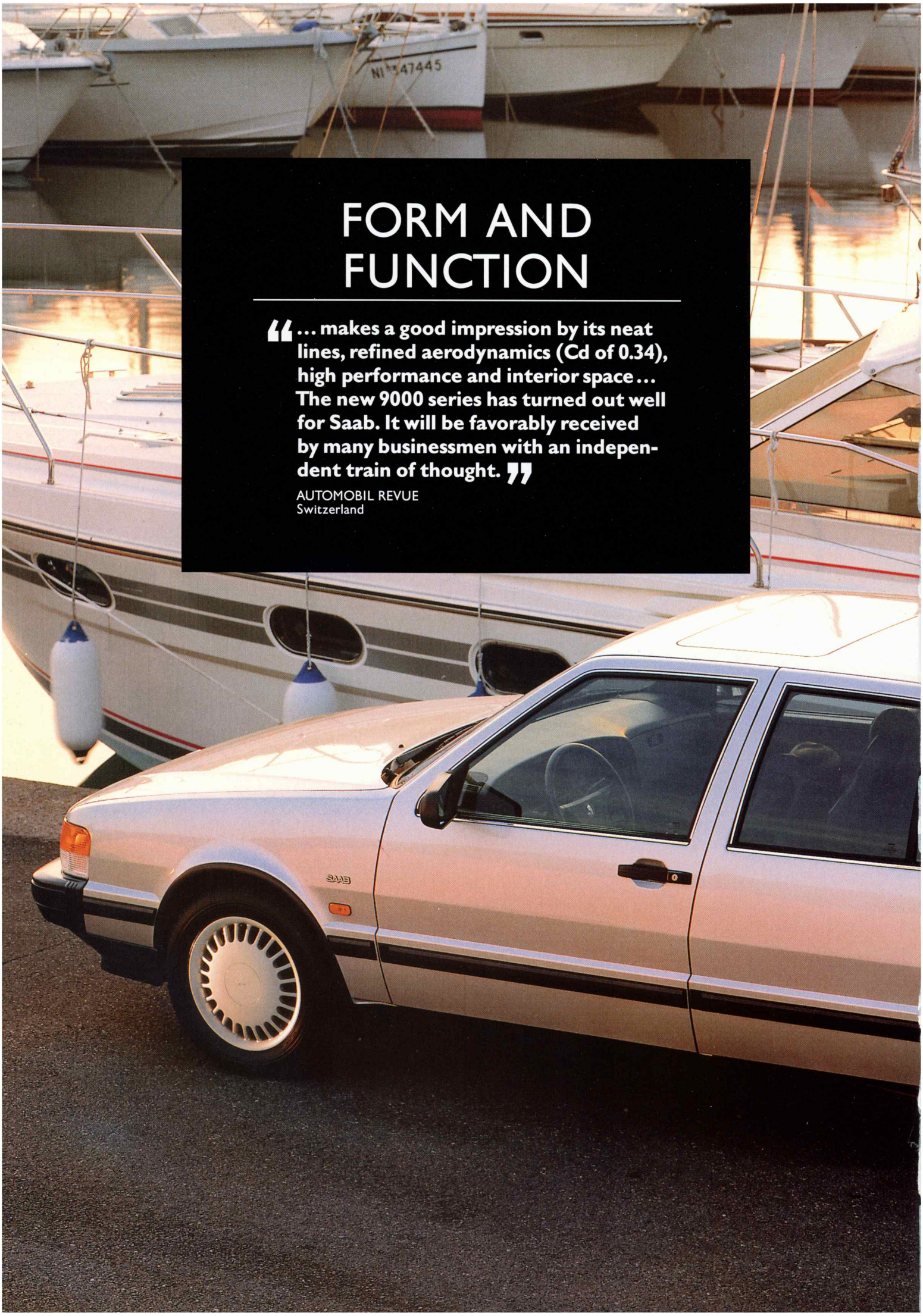
12 All engine compartment components are protected from moisture and corrosion by the application of a special wax.


Asymmetrically-angled instrument panel
Automatic Climate Control (ACC)
16 valves and self-adjusting valve lifters
Saab Direct Ignition
Turbocharger with APC and intercooler
Transversely-mounted engine
Aerodynamic headlamps
Saab anti-lock brakes
Front-wheel drive
Electrically-operated, heated exterior rear-view mirrors
Saab Supplemental Restraint System with driver's side air bag
Driver's seat with a wide range of settings, plus adjustable heating
LUTZ

Ultimately, the quality of a car is determined by the design and material of each component. The illustration shows a Saab 9000 Turbo with some of the details that make it such a sensational car to own and to drive.

Saab 9000 Turbo


Courtesy door-lights with rear-facing warning lamps
Asymmetrically-split folding rear seat back
Level luggage compartment floor
One-piece lightweight rear axle
Self-restoring bumpers
Full bumper-to-roof luggage compartment access



FORM AND FUNCTION

"... makes a good impression by its neat lines, refined aerodynamics (Cd of 0.34), high performance and interior space... The new 9000 series has turned out well for Saab. It will be favorably received by many businessmen with an independent train of thought."

AUTOMOBIL REVUE
Switzerland

SPIRO
SPIRO
36

Roomy as a limousine, but as practical and safe as a family car. Yet it handles and performs like a sports car. If form follows function, the result is a truly distinctive car—the Saab 9000.

Uncommon utility

The Saab 9000 has been designed from the inside out, based on human needs. The driver's cockpit, for instance, has been designed so that virtually any driver, of whatever stature, will easily find his or her ideal seating position.

The Saab 9000 is available as a classic four-door sedan, as well as in the more versatile five-door body style. Both styles have the same basic design, with front-wheel drive and a transversely-mounted engine. In terms of interior spaciousness, all Saab 9000's are classified as "Large Cars" by the U.S. EPA criteria.

Not merely a matter of low drag

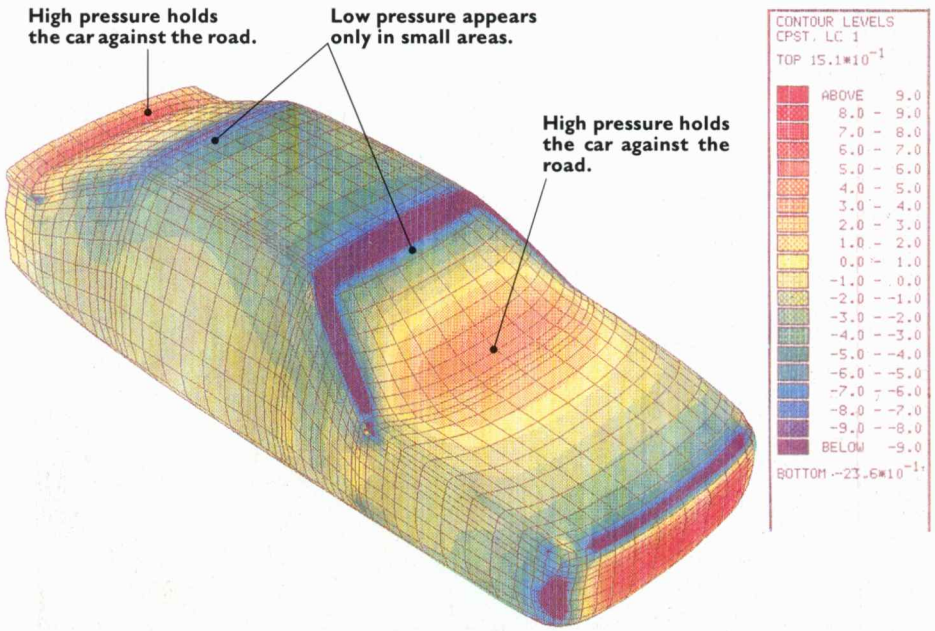
Most people understand that low drag helps to minimize fuel consumption. But the lowest possible drag means a body with inadequate rear-seat headroom. In addition, strong lifting forces will be developed at high speeds. These forces, produced by reduced pressure on the roof and rear, tend to make the car unstable.

The Saab 9000 is not such a car. It is designed for the lowest possible drag consistent with stability in cross-winds and at high speeds, without compromising the car's down-to-earth practicality.

Exterior body surfaces are aerodynamically "clean", and a number of parts and details are flush-mounted. This approach reduces turbulence and wind noise.

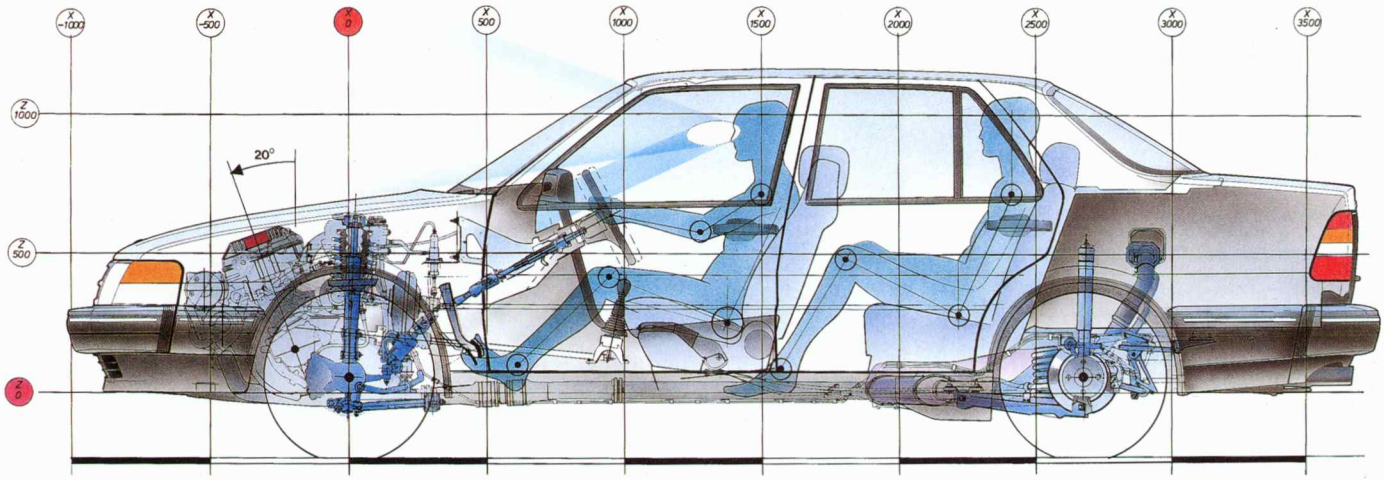
To establish desirable aerodynamic characteristics, the Saab 9000 carries a front spoiler that displaces air ahead of the car to decrease the air pressure beneath. Thus the car is held firmly against the road to improve its stability. The Saab 9000 Turbo 5-door also carries a rear spoiler, which applies additional roadholding forces at high speeds and, in addition, reduces total drag.

Innumerable examples illus-



This illustration displays air pressure on a Saab 9000 travelling at high speed. Red indicates high pressure, yellow atmospheric pressure and blue low pressure.

Specially designed exterior rear-view mirrors cause very little obstruction to air flow, which improves aerodynamics and helps keep side windows clean.



The entire design of the Saab 9000 is based on one factor: the human. The car is designed first and foremost for the driver. The human being's abilities and shortcomings have always supplied the basic criteria used by our designers.

"The Saab is simply very spacious."
AUTOCAR & MOTOR
Great Britain

trate how functional demands have guided the form of the Saab 9000. The interior is large and airy, with ample space in all directions. The luggage-carrying capacity is among the largest in its class. But the Saab 9000 is still shorter than other cars with correspondingly generous space, and it is thus easier to handle in traffic.

Easy to load

In the Saab 9000, loading and unloading are extremely easy. Because the sill is low, only minimum lifting is required. The floor is continuously flat, and (like the sides and wheel housings) lined with heavy-duty molded carpeting. This material is highly sound-absorbent and also provides extra protection for objects being carried.

A shielded lamp illuminates the trunk as soon as the lid is raised.

The right sidewall of the trunk carries a built-in, removable tool box for easy access. The spare wheel is stowed under the floor, where there is also space for useful odds and ends.

A closing handle is provided on the inside of the rear deck lid to protect it from road grime.

Biggest trunk in its class

The Saab 9000 CD has the largest trunk in its class, with a capacity of 18.1 cu.ft. (513 liters). The wide trunk lid can be opened from the driver's seat, or from outside using the key. It is spring-balanced for easy lifting and has a high opening angle.

You can also carry very long items inside a Saab 9000 CD, thanks to a hatch in the rear seat, behind the fold-up armrest. An interior protection bag is available as an optional extra that fits over the hatch and provides useful protection for the car upholstery when transporting, for example, wet skis or fishing poles.

All Saab 9000 5-door models can be expanded quickly and easily from a 5-seat car with a conventional trunk to a cavernous cargo-carrier.

Versatile 5-door models

The luggage carrying capacity of Saab 9000 five-door models can be expanded from the generous trunk of a comfortable sedan to the impressive cargo bay of a station wagon—without compromizing on passenger comfort. The hatchback concept utilizes the best features of different body types and combines them into an attractive and practical entity. The five-door concept also enables valuable and theft-prone luggage to be concealed.

"We moved house recently and the Saab's rare ability to accomodate the sort of awkwardly-shaped objects that would defeat most hatchbacks was exploited as never before. For the record, it swallowed six tea-chests with almost ridiculous ease."

AUTOCAR & MOTOR
Great Britain

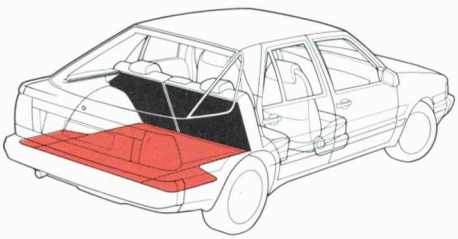
The Saab 9000 CD has a hatch in the rear seat behind the foldable armrest. Long articles can be placed through it.

The luggage compartment can be changed easily to five different capacities. In the classical Saab manner, the entire back seat can be folded down to expand the capacity to the maximum of 56.5 cu.ft. (1600 liters). However, since the back seat is a 60/40 split seat, the cargo capacity can also be expanded in several steps.

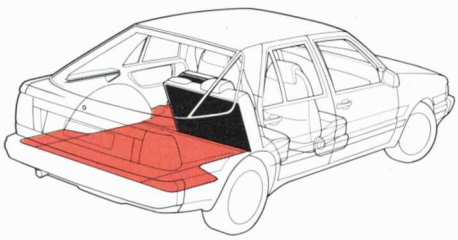
To facilitate loading, the headroom under the fully open tailgate is 5'11" (1800 mm).

Either side of the rear seat cushion can be folded down to provide space for stowing small items of luggage, thus preventing them from sliding around.

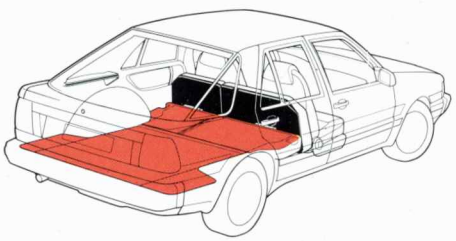
The front part of the center console is built up of modules and contains several different compartments. The lid to the back part of the center console can be folded back to act as a small tray for rear seat passengers.



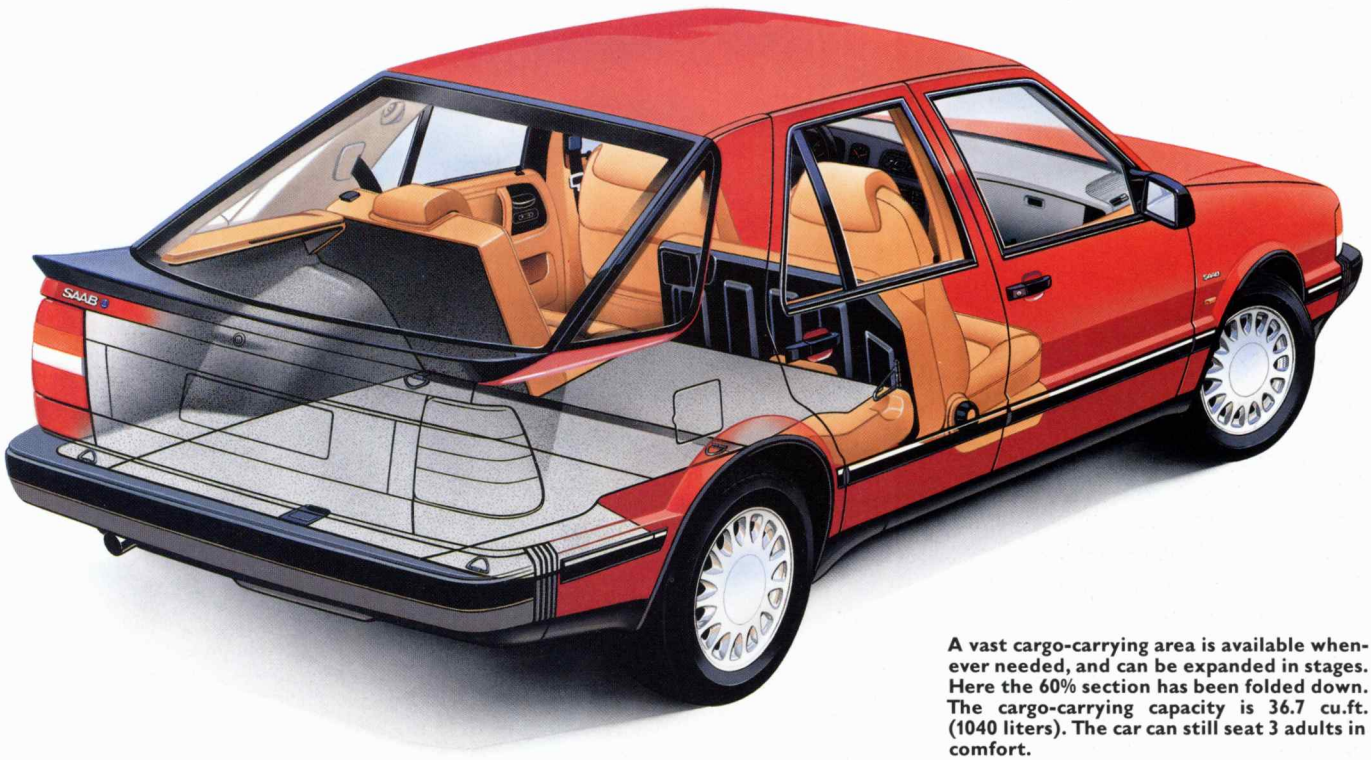
The ordinary trunk of the Saab 9000 5-door has a capacity of 24.3 cu.ft. (688 liters). After removing the parcel shelf, you can carry taller loads, but five adults can still ride incomfort.



The 40% section of the rear seat has been folded down. Two persons can be comfortably seated in the rear. The luggage compartment volume is 32.8 cu.ft. (930 liters).

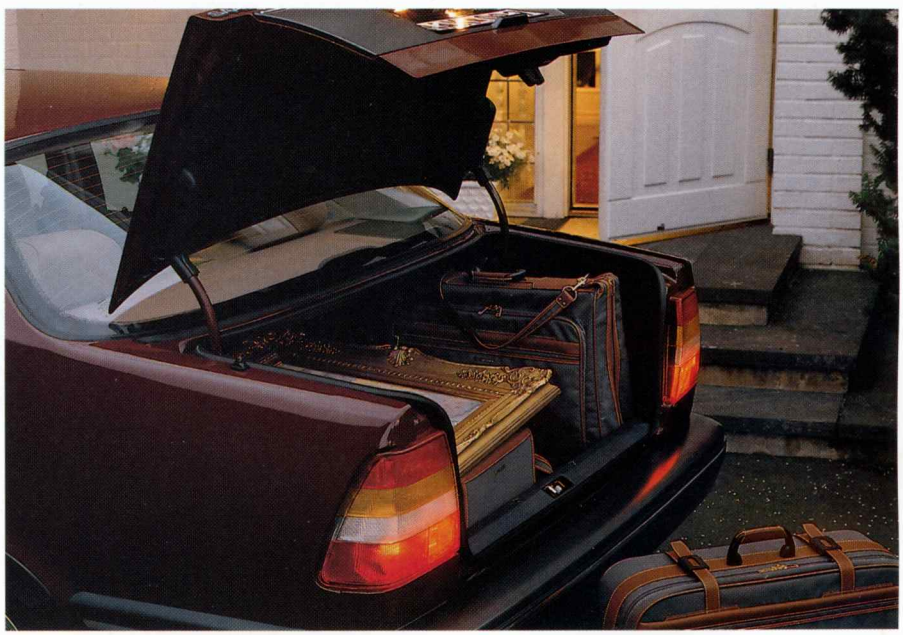


The entire rear seat has been folded down for maximum cargo-carrying capacity. Two persons can travel in the front seats, and the car can accommodate no less than 56.5 cu.ft. (1600 liters) of cargo.



A vast cargo-carrying area is available whenever needed, and can be expanded in stages. Here the 60% section has been folded down. The cargo-carrying capacity is 36.7 cu.ft. (1040 liters). The car can still seat 3 adults in comfort.

The trunk lid of the Saab 9000 CD can be opened from the interior by pressing a button on the inside of the driver's door.



The Saab 9000 CD has the largest trunk in its class. It can be loaded and unloaded very easily, with its low-lift, low-sill flat floor and its high-rise, well-balanced lid.

Form and function

"Large Car" according to EPA standards:
- High standard of comfort.
- Spacious.
- High passive safety.

Transversely mounted engine and front-wheel drive:
- Good weight distribution.
- Excellent roadholding.
- Occupies a minimum of the total car volume.
- Eliminates the need for a bulky propeller shaft tunnel.

Aerodynamic lines of the body:
- Low drag.
- Low fuel consumption.
- Excellent directional stability, even at high speeds.
- Low cross-wind sensitivity.
- Computer-aided design, wind-tunnel tested.

Streamlined external rear-view mirrors:
- Low drag.
- Keeps the side windows clean.
- Deflect on impact.

Spoilers:
- Improve the directional stability at extremely high speeds.
- Reduce the fuel consumption at high speeds, due to good airflow break-away.

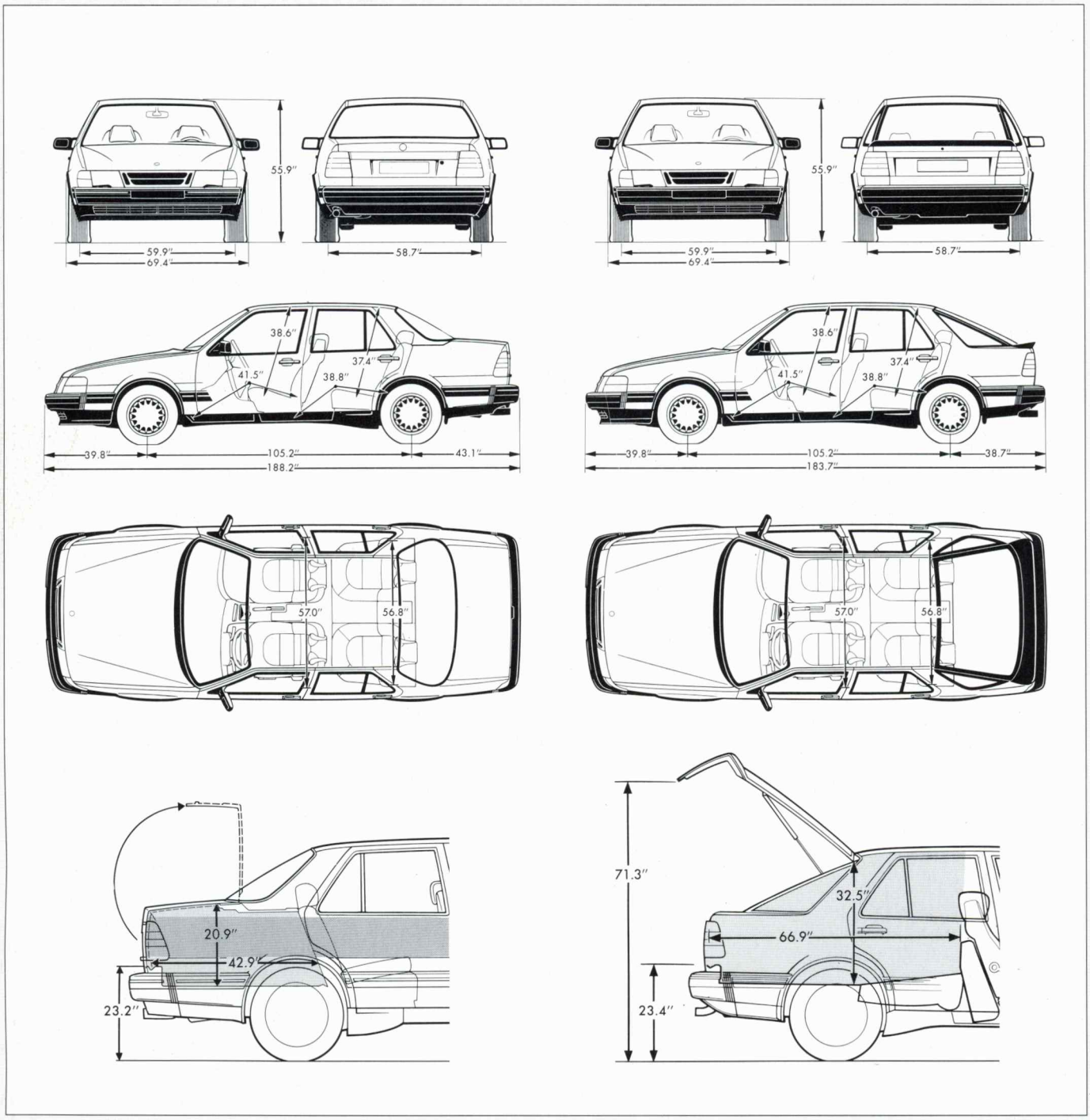
Large capacity of the ordinary luggage compartment:
- Ample space for five people's luggage.
- Capacity of 9000 CD: 18.1 cu.ft. or 513 liters.
- Capacity of 9000 five-door models: 24.3 cu.ft. or 688 liters.

Luggage compartment with flat floor and hatch/trunk lid opening right down to the bumper:
- Convenient loading of even heavy and bulky goods.

Spare wheel under the hatch in the luggage compartment floor. Tools on the side:
- Protected location.
- Easily accessible.
- Additional storage area.

Loading door concealed behind rear center armrest—four-door models:
- Allows carrying of long objects.

Adjustable luggage compartment—9000 five-door models:
- Fully expanded—for two persons and 56.5 cu. ft. (1600 liters) of cargo on a floor area of 21.5 sq. ft. (2 m^2). Vast capacity for bulky goods.
- 60 per cent of rear seat folded —for three persons and 36.7 cu.ft. (1040 liters) of cargo, with a floor area of 17.7 sq.ft. (1.65 m^2). Can accommodate long and relatively wide goods.
- 40 per cent of rear seat folded — for four persons and 32.8 cu. ft. (930 liters) of cargo, on a floor area of 16.1 sq.ft. (1.5 m^2). Suitable for long, narrow items, such as skis.
- Quickly and easily adjustable, without tools.
- Removable parcel shelf provides extra height in the ordinary luggage compartment.



■ All particulars and illustrations in this brochure are based on the specifications of the cars valid at the date of the final editing of the publication. The model range, the technical specifications and equipment vary from one market to the next, and may be altered without prior notice. For further information, please consult your Saab dealer. Note that some of the pictures in the brochure may show cars fitted with optional extra equipment.

Individual strength through combined technology

Saab Automobile AB, the world's newest independent automobile manufacturer, is a company with a vision, and its strength rests on its employees—a team of individuals for whom the design, engineering and production of unique and premium Swedish cars inspires pride and commitment.

Saab Automobile AB has its roots in Saab-Scania AB, a world leader in specialized transport technology. With origins dating back to the 1890's, the Saab-Scania Group has, over the years, created a vast fund of engineering know-how in road and air transportation, as well as in aerospace and electronics.

The first factory-made vehicle produced under the Vabis name appeared in 1897, and in 1901 Scania made its first passenger car, bearing the Griffin symbol on the radiator. The first truck was produced in 1902 and in 1911, the first bus. In the late 1930's, the production of Saab aircraft was started. The production of Saab passenger cars commenced in 1949.

Today the Saab-Scania symbol, with the Griffin in its center, can be found on a variety of products including Saab passenger cars, Scania trucks and buses, Saab regional airliners and military aircraft, as well as a wide range of high-tech products made by the Saab-Scania Combitech Group such as space satellites, training systems and military robots.

In every area the Saab-Scania symbol stands for excellence in engineering, long tradition and broad-based experience.

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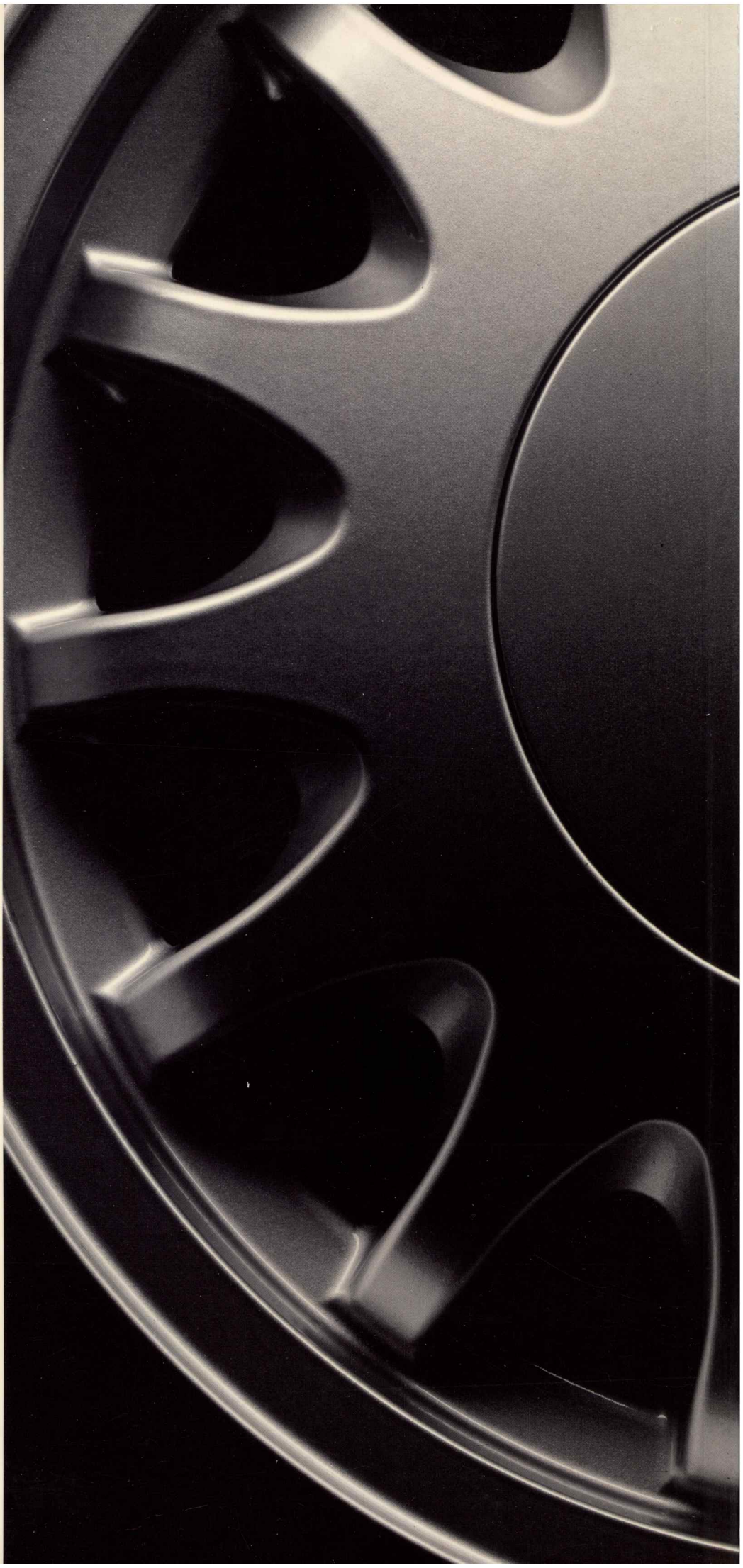

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